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Cover: The JOHN G. MUNSON locks through the Poo Lock of the Soo locks at Sault Ste. Marie, prior to the closing of that lock. The smaller MacArthur Lock remained open throughout the winter. Photo courtesy of Dwight Boyer, Cleveland Plain Dealer.

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Mariners Weather Log

MODEL FOR A STUDY OF CHESAPEAKE BAY

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Construction of a model of Chesapeake Bay (fig. 1) is no small task, as the bay is one of the largest estuarine systems in the world, having a surface area of about 4,400 sq mi and a length of approximately 195 mi. As is typical of coastal plain estuaries, Chesapeake Bay is a broad, shallow expanse of water varying from 4 to 30 mi in width and having an average depth of less than 28 ft, with a maximum of 174 ft. The depth of the ship channel is at least 42 ft. The more than 50 tributary rivers feeding freshwater into it drain an area in excess of 64,000 sq mi. Each of these rivers has its own geochemical-hydrologic characteristics. The largest of these, the Susquehanna, provides over 50 percent of the freshwater inflow. The bay was formed more than 10,000 yr ago when the Atlantic Ocean drowned the last 200 mi of the Susquehanna River, which starts in Lake Otsego, N.Y., and now flows 453 mi to the bay.

The ebb and flood of the tides are the most readily perceptible water movements in the bay, even though the mean tidal fluctuation is small, generally between 1 and 2 ft. Superimposed on the tidal currents in the bay and its tributaries is a nontidal, two-layered circulatory pattern. One part of the pattern produces a net seaward flow in the upper layers of the bay; the other, a flow up the estuary in the deeper layers. These layers are predominantly a function of the variation in salinities -- which range from 35 parts per thousand at the bay's mouth to near zero at the north end of the bay and the heads of tributary embayments. In fact, the salinity variations constitute the most significant physical parameter influencing the circulatory dynamics of the estuary.

The physical and chemical dynamics of Chesapeake Bay make it biologically a very special place. Its 7,300 mi of shoreline and immense wetland areas and shallows provide not only food, but also a sheltered nursery area, for larval and juvenile animal forms. Salinity variations within the bay encourage colonization by aquatic organisms of both fresh and saltwater origin. The bay's crop of both fin and shellfish is legendary. The most important economically are the soft-shelled clams, oysters, blue crabs, menhaden, and rockfish (fig. 2). Most of the 239 recorded species are permanent residents, but many ocean spawners also use the bay--as a nursery for their young.

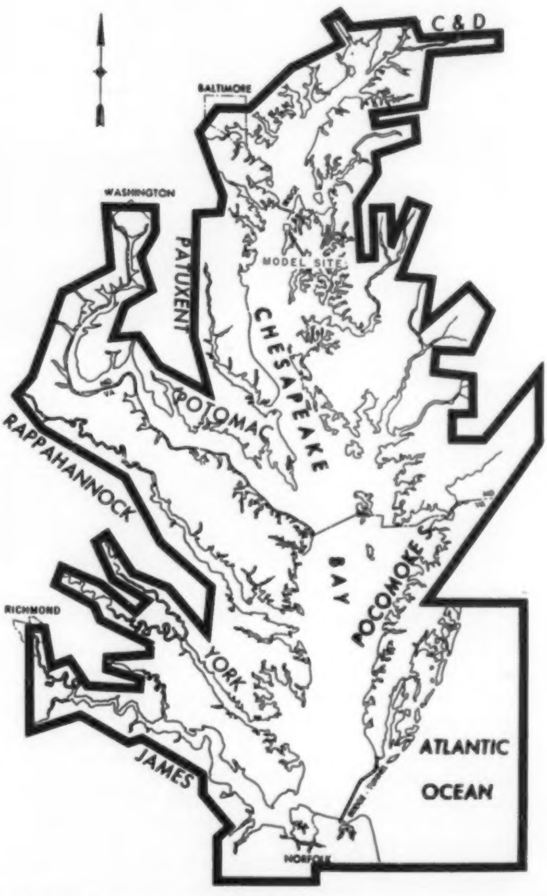

Figure 1.--Approximate limits of the Chesapeake Bay Model.

Figure 2.--Commercial fishermen with nets and oyster tongs are common to the bay, indicating the importance of the seafood industry to the region's inhabitants. Chesapeake fishermen also rely on the rapidly vanishing "bugeye" and "skipjack" sailboats unique to the bay.

Figure 3.--Preserving the beauty and dignity of Chesapeake Bay includes awareness of the respective roles played by historic Fort McHenry and waterborne commerce near Baltimore Harbor. Port of Baltimore Photo.

Man settled early along the bay's shores, first the Indian tribes and later the colonists, for nearly the same reasons, food and transportation. Captain John Smith, with a crew of rowers, first explored the bay in 1608. In 1634, there was a trading post on Kent Island. Colonists in particular were dependent upon the Chesapeake for a means of travel, not only as an access to the ocean and the motherland, but to other settlements along the bay and into the hinterlands. And the bay's importance as a means of travel has not diminished with time. Through the romantic clipper ship and side-wheeler era, an increasing number of boats have dotted its waters. The clipper and side-wheeler are gone now, replaced by today's large ocean-going freighters and tankers, and, even more evident, over 125,000 pleasure boats.

As the sea-going commerce grew, so did its attendant ports. Norfolk, Newport News, and Hampton Roads (at its mouth), Richmond (at its middle), and Baltimore (on the headwaters) were all a product of this growth. In 1970, about 150 million tons of foreign and domestic cargo were shipped on the bay (fig. 3). Baltimore alone handled over 24 million tons of foreign cargo, valued at $2 billion, in 1971.

Transportation, however, is by no means the only way that man benefits from the bay. Thousands of

Figure 4.--Wind and wave action threatens existing property by eroding the shoreline.

commercial fishermen earn their livelihood harvesting a variety of fin fish, oysters, clams, and crabs, while still others process these gastronomical delicacies so that they may be enjoyed throughout the region and the Nation. Millions of people flock to its shores for such pleasurable activities as boating, fishing, swimming, water skiing, picnicking, or just a few minutes of relaxation. Tourists from all over the country visit the origin of their heritage in such historic places as Williamsburg, Annapolis, and the Nation's Capital, Washington, D. C. Great cities and industries have located along its shore--located there because of the great abundance of water, or because of the Chesapeake's effectiveness in assimilating their wastes.

Chesapeake Bay, however, is beginning to feel the effects of the intrusion of both man and natural forces. Its upper reaches are sometimes covered with algae--algae caused by human, agricultural, and industrial wastes. Very large electrical powerplants are being planned and constructed, and who knows what effects the heated discharges will have on the biota. The forces of winds and waves are gradually eroding the shoreline, and islands which were once there have disappeared (fig. 4). Man, in building his great urban society, has denuded the land to such an extent that it readily erodes; and soil is carried by rainwater to the bay, where it settles to the bottom. Lastly, in his quest to accommodate the ever-increasing numbers of people, man has begun to fill and destroy the bay's environmentally invaluable wetlands.

How far can man continue to use the bay without causing irreparable damage? This was the question facing the Baltimore District Engineer when, in October 1965, Congress directed the Corps of Engineers to make a complete investigation and study of water utilization and control of the Chesapeake Bay Basin, and to construct, operate, and maintain, in the State of Maryland, a hydraulic model of Chesapeake Bay.

The bay's problems are perplexingly complex, and their solution requires the expertise found in many different disciplines. No single entity could be expected to have the requisite personnel, equipment, and technical know-how necessary to accomplish this comprehensive investigation by itself. Such expertise does exist, however, among the many agencies which have been historically responsible for certain features of water resource development. The Chesapeake Bay Study is, therefore, conceived as a coordinated partnership between Federal and State agencies and interested educational institutions. Consequently, an elaborate coordination mechanism was established which provided for an Advisory Group to provide the Baltimore District Engineer with broad guidance, a Steering Committee to keep him abreast of technological advances, and five Task Groups to function as basic work groups. Through this mechanism, constant liaison, work review, and requisite agency interaction are being maintained between the various participating agencies.

All of these people are working toward a common goal--the most constructive use of Chesapeake Bay's

Figure 5.--The areas of the model that simulate wetlands are scored to create artificial roughness.

numerous, but limited, resources, while still maintaining the bay's natural beauty, dignity, and ecosystem. It will take much effort to achieve this. The Chesapeake's capacity to support activities of all types must be assessed, and the future demands that can be placed upon it must be determined.

It is also necessary to understand the bay, to understand what it is and what makes it that way. This is a tremendous task, a task that can only be achieved through the use of tools which reduce the bay to an understandable and manageable scale. Such a tool will be the hydraulic model of Chesapeake Bay.

The use of models in studying hydraulic problems is by no means a new concept. It is an evolutionary outgrowth of many centuries of applied and theoretical engineering studies. Although very little has come down to us about the knowledge of the movement of water possessed by the ancients, it is well recognized that the hydraulic arts were practiced before the dawn of recorded history. The Americas, Europe, Asia, and Africa all contain samples of early significant hydraulic works.

Lake Moeris was constructed about 4,000 yr ago to store flood waters of the Nile. Twenty-five hundred years ago, a navigation canal, which the present Suez Canal closely follows, connected the Red Sea with the Mediterranean. Significant flood protection works were constructed 4,000 yr ago by the Emperor Wu, an outstanding Chinese hydraulic engineer. The Roman Senate considered cutting through a river bend of the Tiber that threatened Rome; and one of the greatest geniuses of all times, Leonardo da Vinci, built the first chambered navigation locks in the world near Milan, 500 yr ago.

Most early hydrologic researchers used laboratory equipment with which they attempted to model natural hydraulic phenomena. It was not until 1875 that the French engineer Farque applied hydraulic modeling techniques to solving a problem arising from actual engineering practice. The second attempt to use a hydraulic model for an operating problem took place in England, in 1885, when Professor Osborne Reynolds built the first estuarine model to study the effects of proposed works on the Mersey River Estuary.

Reynolds' Mersey model was built with a horizontal scale of 1 to 31,800, and a vertical scale of 1 to 960. Tidal cycles with 1-min periods were generated by a water-filled, hand-operated, hinged pan at the ocean end of the model. The construction of this model represented a definite advance in that it was the first time a time factor was introduced into a hydraulic model study. Because of Reynolds' study, the pro-

Figure 6.--An interior view of the vast area housing the Chesapeake Bay Model, as the replica of the bay starts to take shape on Kent Island.

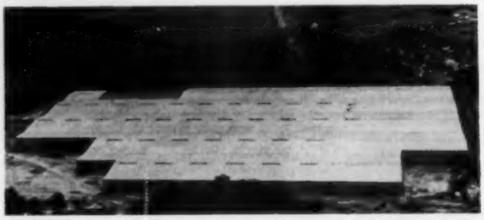

Figure 7.—Aerial view of the 14.5-acre shelter for the Chesapeake Bay Hydraulic Model. Picture taken in August 1974.

posed works on the Mersey Estuary were extensively revised. Reynolds also called attention to the fact that hydraulic models had potential for use in pollution studies.

Since the time of Reynolds, the types of studies performed with estuarine models have been continuously expanding. Within the past 40 yr, many important techniques have been developed that have made these tools much more versatile and reliable. Of primary value has been the realization that the density phenomenon plays an important role in estuarine processes. This led to reproduction of this phenomenon by introducing saltwater into the model through a model ocean, and freshwater through simulated fluvial inflows.

Another development of great importance has been the use of thin metal strips cast into the concrete bottom as a means of providing artificial resistance to the flow of water. These strips are adjusted until they cause the same degree of roughness (fig. 5) caused by the natural bottom of the real bay. This development made possible, for the first time, model studies of waste water dispersion and diffusion which Reynolds had envisioned years before. The refinement of these necessary techniques by the Corps of Engineers' Waterways Experiment Station (WES) at Vicksburg, Miss., eventually fulfilled Reynolds' predictions regarding the usefulness of hydraulic models for pollution studies.

Today, hydraulic models are much larger and more sophisticated than those used by the early pioneers such as Reynolds. Their very construction and successful operation are a significant engineering accomplishment. In fact, the effective use of a hydraulic model requires a complete integration of many scientific and engineering skills, including those of the hydraulic engineer, hydrologist, oceanographer, and field surveyor, to name a few. This is particularly true of the 9-acre indoor Chesapeake Bay Hydraulic Model now under construction which, when completed in the spring of 1976, will be the largest estuarine model in the world (figs. 6 and 7). The building housing it will occupy 14 acres. This model will encompass the bay proper, all of its tributaries up to the head of tidal effects, and the adjacent overbank areas to an elevation of 20 ft above mean sea level. Also included will be the Chesapeake and Delaware Canal (fig. 8), and a portion of Delaware Bay.

Figure 8.--The Chesapeake and Delaware Canal, as reproduced in the Chesapeake Bay Hydraulic Model. The resistance strips imbedded in the model will be adjusted to "fine tune" the model so that it accurately reproduces to scale the hydraulic characteristics of Chesapeake Bay.

Figure 9.--Worker carefully incorporates topographic features into the model. Templates used to mold the model can be plainly seen.

The design of the hydraulic model of Chesapeake Bay was carried out at WES. This work involved extensive hydrologic and hydraulic studies to size the hydraulic components of the model water supply system and to establish water requirements for the various operating modes. Included in the design work on a prototype of the model were careful topographic studies to develop the data from which the templates used to mold the model were plotted. Approximately 26 mi of templates are being placed during the model construction phase (fig. 9). Also, intense study was devoted to the design of a system to control the generation of tides in the model ocean and control the freshwater that simulates river inflows into the estuarine system.

As previously stated, the bay conforms to the typical form of coastal plain estuaries, which are generally broad, shallow water bodies. The average depth of Chesapeake Bay lies between 25 and 28 ft. If the model were to be constructed to a reasonable natural scale, water depths in certain areas would be extremely shallow. Because of this, not only would the water be too shallow to make meaningful measurements, but the effects of water surface tension would disturb model test results.

To overcome these problems, the bay model, like almost all estuary models, will be geometrically distorted. This means that it will be constructed disproportionately by using larger linear scales for vertical dimensions than those used for its horizontal dimensions. The degree of distortion, as well as the actual scales selected, is dependent on many factors, including the size of the area that must be reproduced and the problems to be investigated.

The Chesapeake Bay Model, therefore, will be constructed with scales of 1 to 1,000 horizontally, but only 1 to 100 vertically. This combination of scales is referred to as a distortion ratio of 10. This particular scale ratio has been found, over many years of experience, to provide the most economically sized model that will accurately reproduce the vertical and lateral distributions of current velocity, salinity, and tidal elevation. The model's geometric scales also determine its time scale. A 12-hr and 25-min tidal cycle can be reproduced by the model in approximately 7.5 min. This compressed time scale allows a 1-yr testing period to be reproduced in the model in a little over 3-1/2 days.

An extensive prototype data-collection program was initiated concurrently with the design phase. This involved the collection of data concerning tidal elevations, tidal current velocity, and salinity, at various points throughout the bay system. Tidal elevation data were collected at 72 locations for at least a 1-yr duration by the National Ocean Survey, which also conducted a 1,000-mi survey to establish a common reference datum for the tidal stations. Current velocity

and salinity data were acquired at 105 different stations in the estuarine system for periods ranging from 3 to 5 days. This work was accomplished under contract with Johns Hopkins University, the University of Maryland, and the Virginia Institute of Marine Science. These data were collected to provide a valid basis for verifying that the model's hydraulic and salinity phenomena will be in acceptable agreement with the prototype.

The problems encountered in coastal or estuarine areas very often reflect the accelerating urban development and the population, industrial, and transportation base necessary to support this type of development. These are manifested in needs for improved navigational facilities, expanded water supply and waste water facilities, and increased energy requirements. These requirements -- some of which cause physical and related biological changes--will be studied with the aid of the model, by comparing the results of tests reflecting the existing regime with those reflecting changed conditions.

The problems that arise from navigation improvements, for example, are many and challenging. First of all, channels must be dredged, and this poses the problem of spoil material disposal. For when dredged materials are deposited overboard, spoil may return to the channel and add to maintenance problems and costs. Also, the fraction of this material which remains in suspension causes turbidity, thereby displacing biological processes. Increasing channel dimensions may also permit saline water to penetrate farther upstream than had previously been possible. This, in turn, may cause heavier shoaling, a shift in shoaling location, or biological damage. Finally, the presence of navigation channels close to shore may increase shoreline erosion because of the greater effects of wave action. As an aid in studying transport of sediments and shoaling patterns, "Gilsonite" (a finely ground or pelletized plastic) will be used to indicate the percentage distribution of sediments and areas of scour, in the model.

Another problem that can have serious consequences is reducing the quantities of freshwater entering Chesapeake Bay. Among other things, this could alter the salinity regime and other physical characteristics of the bay, thereby creating an adverse environment for the propagation of aquatic life. These freshwater reductions could occur in many ways, including extensive droughts, interbasin transfers of water from tributary streams, and extensive ground water mining. The hydraulic model can be used to monitor these changes and to develop plans for mitigating their effects.

Possibly the most damaging aspect of man's presence is the large volume of untreated or partially treated wastes that is discharged into the bay. Hydraulic model studies, through the use of dye injections, will be useful in determining the flushing characteristics of both the bay proper and its tributary embayments. At the same time, model studies will help in locating waste water outfalls where the least damage will be done. Further, where the discharge of particularly deleterious municipal or industrial wastes, radioactive wastes, or significant oil spills is a distinct possibility, the model will be used to look at the possibilities for the translocation of the wastes through the Chesapeake Bay system.

Unrestricted use of the Nation's waters for the dissipation of waste heat is as dangerous as the discharge of the more obvious domestic and industrial wastes. The large generating capacity of contemplated thermal powerplants is forcing public utilities operators to look to the estuaries to meet the increasing demand for cooling waters. Because little is actually known about heat discharges, hydraulic model studies are important in preselecting plant sites, determining changes in the hydraulic regime caused by plant construction activities, and estimating the resulting temperature changes.

The process of landfilling and reclamation, besides having the potential of being ecologically unsound, can also cause changes in estuarine hydraulics. If the water area is significantly reduced, the existing current and tidal regimes can be altered, reducing the bay's capacity to assimilate waste and flush itself. Here again, the hydraulic model will prove valuable in assessing the practicability and long-term effects of landfill operations.

The current systems, tides, and water quality of Chesapeake Bay are complex and highly variable over time and space. When the works of man are superimposed on a regimen controlled by astronomic, meteorological, and hydrologic forces that are as yet incompletely defined, it is immediately evident that even the most geometrically uncomplicated estuary is a most difficult water body to understand. These difficulties are compounded many times over by an estuarine system as complicated and extensive as Chesapeake Bay. The hydraulic model, used in conjunction with both analytical and field studies, will greatly assist water resource planners in realizing the most beneficial use of Chesapeake Bay and her bountiful resources.

ACKNOWLEDGEMENTS

This article is an update of an article that was published in the Vol. 5, No. 2, 1973 issue of Water Spectrum, a publication of the U. S. Army Corps of Engineers. A few items of history were added by the editor, who wishes to thank the Corps of Engineers for permission to use this interesting article, and particularly David C. Mitchell, Chesapeake Bay Study Group, for his cooperation.

GREAT LAKES NAVIGATION SEASON, 1974

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The 1974 Great Lakes navigation season got off to a slow start. The original opening date was April 1 for the St. Lawrence Seaway, Welland Canal, and the Sault Ste. Marie Locks. The Seaway opening was advanced to March 26, the earliest in its history, but high winds, subzero temperatures, and a seamen's strike immobilized most of the fleet. A river pilots' strike halted navigation from April 9 through 20 in the Montreal-Quebec area.

The first vessel to enter the Iroquois Lock was the CANADIAN HUNTER, on March 26. The Yugoslavian ALKA led the westbound traffic by clearing the St. Lambert Lock on March 30.

The Welland Canal opening was advanced to March 29 with the Canadian MEDFORD leading upbound traffic, and the SEAWAY QUEEN, downbound. The Belgian FEDERAL ST. LAURENT was the first overseas traffic, on April 6 (fig. 10).

The U.S. locks at Sault Ste. Marie were placed in operation on April 1, but, due to heavy ice in the St. Marys River, the first transits were not until the 2d, when the USCG Icebreaker MACKINAW led a convoy of eight Canadian lakers, headed by the R. BRUCE ANGUS, upbound through the Poe Lock. The Canadian Soo lock opening was changed from April 4 to the 12th, due to the heavy ice conditions. The first overseas ship was the Liberian SACHA, on April 25.

Traffic through the Straits of Mackinac began on March 26, when the icebreaker SOUTHWIND escorted four Canadian freighters into Lake Michigan.

The December 18 closing date for the St. Lawrence Seaway was 4 days earlier than 1973. In mid-December, the December 30 scheduled closing of the Welland Canal was advanced to January 17, 1975, 9 days later than any previous closing (fig. 11). The Canadian canal at Sault Ste. Marie closed on December 12. The Poe Lock did not close until March 1, 1975, and smaller boats used the MacArthur Lock throughout the ice season. The GEORGIOS A. was the last eastbound saltie to clear the St. Lambert Lock, on December 18. The final upbound through the Iroquois Lock was the Canadian freighter FRANK A. SHERMAN. The last outbound overseas vessel through the Welland Canal was the British freighter DEMETERTON, on the 15th. This was also the last oceangoing vessel to pass through the Soo Canal, on December 12.

All the Lakes were above their average level. The

Figure 11.--NORTHERN VENTURE downbound in the Welland Ship Canal on January 17, 1975, with cargo of coal for Hamilton steel mills. Another Canadian vessel, FRONTENAC, was the last upbound (in ballast) and cleared the canal into Lake Erie early on January 18. Photo courtesy of St. Lawrence Seaway Authority.

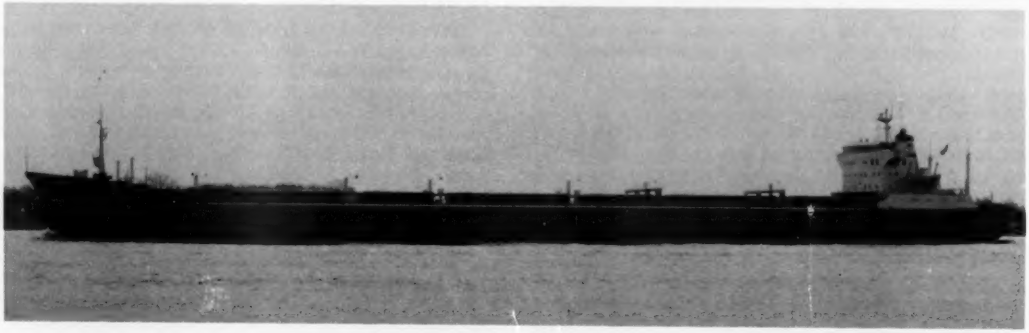


Figure 10.--FEDERAL ST. LAURENT, Belgian, 681 ft--third overseas vessel to enter the Seaway, and first beyond Lake Ontario. Photo courtesy of Great Lakes Commission.

only exception to this was Lake Ontario during November and December. A new record high was set on Lake St. Clair during May 1974. The levels of all lakes are expected to be slightly lower during 1975 than in 1974, but still above average. Flooding will again be a danger during storms in 1975.

The annual precipitation for the whole basin was 8 percent below normal at an average of 28.94 in, versus a normal of 31.56 in. The drainage basin for three lakes, Superior, Huron, and Ontario, had below-normal rainfall, while Lakes Michigan and Erie were above normal. Lakes Superior and Huron were both over 5 in below normal. The preceding 2 yr, all lakes were above normal. (See table 1.)

See the abridged index in the November 1974 issue for items published during that year concerning the Great Lakes.

Table 1.--Annual precipitation data for 1972-74

	Great Lakes	Lake Ontario	Lake Erie	Lake Huron	Lake Michigan	Lake Superior
1972 (in)	35.97	43.67	39.70	35.32	34.97	32.22
1973 (in)	33.87	38.16	37.01	33.34	33.98	30.84
1974 (in)	28.94	33.42	34.14	25.92	32.77	23.86
1974 departure (in)	-2.62	-0.92	+0.30	-5.30	+1.47	-5.77

NOAA NATIONAL WEATHER SERVICE AIDS

Full weather services were provided throughout the Great Lakes navigation season, 1974. Services to commercial shipping were provided from late March through the remainder of the calendar year, and through at least February 1975. A record late date for navigation was set on February 8.

National Weather Service Forecast Offices in Chicago, Detroit, and Cleveland continued to serve as focal points for marine services during the year 1974. The Buffalo, N.Y., Forecast Office was added as a new member of the team in July, when it assumed responsibility for Lake Ontario and the St. Lawrence River, from the Cleveland Forecast Office.

Marine radio stations at Duluth, Port Washington, Chicago, Rogers City, Buffalo, and Lorain broadcast coded open-water forecasts (MAFOR) every 6 hr. They also broadcast plain-language gale- and storm-warning messages and Special Marine Warning Bulletins. Nearshore forecasts supplemented the open-water forecasts and were issued by 15 Forecast and Weather Service Offices around the Great Lakes. Radio stations WMI, Lorain, Ohio, and WLC, Rogers City, Mich., broadcast the Lakes Weather Broadcast every 6 hr.

The National Weather Service expanded their own VHF radio broadcast network late in the year with the addition of stations at Green Bay, Wis.; Grand Rapids, Sault Ste. Marie, and Marquette, Mich.; and Duluth, Minn. Plans were also unveiled for new stations in early 1975 at Alpena, Mich., and Rochester, N.Y. The U.S. Coast Guard broadcast gale and storm warnings, as well as Special Marine Warning Bulletins, on 11 of their stations. Four stations continued to broadcast routine weather information every 2 or 3 hr, depending on the needs of the service area.

The radio facsimile system, which was being tested on a limited basis, was expanded during the latter months of the 1974 season. New equipment, which proved to be much more reliable, was installed on 30 boats for late-season navigation. Wind and temperature forecasts were broadcast by all of the Lorain Electronics-owned stations, as well as U. S. Steel's station in Rogers City. Ice charts were also broadcast under a joint project between the Weather Service, U.S. Coast Guard, and NASA's Lewis Research Center in Cleveland.

Gale warnings for calendar 1974 for all the Lakes totaled 279--down considerably from the 372 warnings in 1973, and 329 in 1972. This was a decrease of 20 percent. Storm warnings totaled 22--7 less than the previous year.

During the ice season, routine National Weather Services ice information and forecast service was provided from the Weather Service Forecast Office in Detroit, and from the joint NWS-USCG Ice Navigation Center in Cleveland. Daily products, as well as less frequent 30-day ice outlooks, were issued for dissemination by mail, teletype, and facsimile.

ICE SEASON

An article describing the 1973-74 Great Lakes ice season, by Daron E. Boyce, National Weather Service, Cleveland, Ohio, appeared on page 298 of the September 1974 issue of the Mariners Weather Log.

Great Lakes mariners were tested to their fullest during the 1973-74 ice season--especially on the northern waters. Below-normal temperatures brought severe ice conditions to Lake Superior, the Straits of Mackinac, and the St. Marys River by early February. Shipping ended abruptly on February 7, 1974--1 day short of the previous record late date. The spring 1974 opening also proved to be unusually challenging in the Upper Lakes. Temperatures over the southern waters were above normal for the third straight year, and an easy season was the rule.

Shipping was active through the fall months of 1973. Abnormally cold weather in early November dropped water temperatures in the Upper Lakes sufficiently to produce some skim ice at Duluth on November 10. Warmer weather for the remainder of the month delayed further development. Cold air masses spread over the Lakes during the second week of December, and ice formed quickly at Duluth, Green Bay, the Straits of Mackinac, the St. Marys River, and Saginaw Bay by midmonth.

With the fuel shortage and generally favorable fall

Figure 12.--CHEMICAL TRANSPORT finds the going tough in the ice-covered St. Marys River. Photo courtesy of Dwight Boyer, Cleveland Plain Dealer.

weather, the St. Lawrence Seaway and Welland Canal closings were delayed. Closing dates were December 20 and January 4, respectively. Continued ice growth in December caused difficult conditions near Duluth, Saginaw Bay, Green Bay, and Lake St. Clair. Five ships were assisted in Saginaw Bay. Much colder weather by New Year's Day resulted in rapid reformation and growth of ice--especially in the Upper Lakes.

The abnormally cold weather continued into January, and ice increased in coverage and thickness in the northern sections. By midmonth, ice coverage was nearly complete in St. Marys River (fig. 12), Green Bay, Straits of Mackinac, Saginaw Bay, Lake St. Clair, and western Lake Erie. Only a few ships continued to operate through the severe cold and biting winds of late January.

The annual January thaw arrived as if scheduled, during the third week of January, but wintry weather resumed in early February, and icebreaking assists increased markedly. Ice conditions worsened to the severe level by the end of the first week. Three-foot-thick ice in the Straits was reported by the SOUTHWIND. Navigation through the Soo locks ended on February 7, 1974.

Milder weather spread over the Lakes region during the last few days of February and continued through the first week of March. Storms brought frequent rainfall with southwesterly winds and resulted in substantial melting. The southwesterly gales created problems in the eastern end of Lake Erie as the ice jammed into restricted areas. Some loss of ice cover also occurred in northern waters.

Late winter's fickleness persisted into the remainder of March, with alternating weeks of cold and mild weather. Lake St. Clair was ice-free, and Lake Erie's ice remained only in the eastern end by the second week of March. Colder weather the third week resulted in new ice in Lake Superior and the Straits of Mackinac, and high winds increased the pressure at Buffalo.

Encouraged by mild-weather periods during the latter days of March, some ships ventured out of port. The St. Lawrence Seaway opened 6 days early, on March 26, followed by the Welland Canal on March 29. The first commercial ship through the Soo locks was the Canadian R. BRUCE ANGUS, on April 2. U. S. ships waited until later in April.

Southwestern Lake Superior, Whitefish Bay, the Straits, and Green Bay remained nearly ice-covered and difficult for navigation during the early part of April. Abundant sunshine and milder weather decayed the ice in the Straits, and only drift ice remained by midmonth. By the end of the third week, much open water existed in Whitefish Bay and the St. Marys River. Areas of greatest difficulty through the remainder of April were the southwest corner of Lake Superior and the bays behind Isle Royale. Duluth was ice-free by April 26, but some drift ice was left in the open lake until about May 1, 1974.

GREAT LAKES OBSERVATION PROGRAM

There were 32 vessels that participated in the Great Lakes weather-reporting program this year. A total of 11,952 observations were sent by the participating ships. This was a decrease of 2,456 observations from 1973. The following number of observations by lake were reported: Lake Ontario, 69 by 5 ships; Lake Erie, 659 by 27 ships; Lake Huron, 3,060 by 31 ships; Lake Michigan, 1,869 by 29 ships; and Lake Superior, 6,295 by all 32 ships.

During the year, gale-force or higher winds (34 kn or greater) were reported on 97 days. There were 1 day with gales (34-40 kn) on Lake Ontario, 11 on Lake Erie, 26 on Lake Huron, 22 on Lake Michigan, and 56 on Lake Superior. Strong gales (41-47 kn) occurred on 2 days on Lake Erie, 6 days on Lake Huron, 1 day on Lake Michigan, and 8 days on Lake Superior. Storm winds (48-55 kn) occurred on 1 day on Lake Erie. December again had the most days with high-wind observations, followed by October and November. Table 2 shows the number of high-wind observations by 10-kn categories.

Table 2.--Number of high-wind observations during calendar year 1974

High-wind categories	Observations
Over 30 kn	405
Over 40 kn	22
Over 50 kn	0

A total of 27 observations were made of seas over 12 ft. There were 25 observations of waves 13 to 15 ft, and 2 of 16 to 20 ft. December had the highest number both of days and observations of high waves. The highest reported was 18 ft by the CASON J. CALLOWAY on September 24, on Lake Michigan. Seas over 12 ft were reported one time each on Lake Erie and Lake Huron. There were 2 days with two observations on Lake Michigan, and 17 days with 21 observations on Lake Superior.

Tables 3 to 10 give summaries of the maximum winds for each lake by month, the highest wind by month on any lake, the highest 1-min wind by lake for each year since 1941, and the highest seas reported on each lake this year. The tables include only those observations that were logged and forwarded on the Great Lakes Observation Form 72-2.

NOTABLE WEATHER HAPPENINGS

INTRODUCTION

December was again the stormiest month for shipping on the Great Lakes. It surpassed the other months both in days with, and observations of, high winds and waves. November and October followed in that order. The highest measured synoptic wind reported was 48 kn, on December 1, on Lake Erie, by the CHARLES M. WHITE. The highest wind was 52 kn during a thunderstorm over Lake Superior in July, reported by a special observation from the LEON FALK. The highest wave was 18 ft, on September 24, on Lake Michigan, by the CASON J. CALLOWAY. There was one ship lost this year with weather involved. The JENNIFER sank about 20 mi northeast of Milwaukee, on December 1, when her cargo shifted. The waves were reported as 8 to 10 ft at the time, but apparently no cooperating ship was in the area, as no Form 72-2 was received with winds over 30 kn or waves over 7 ft.

There were several interesting statistics obtained from a printout of selected observations. One was the few thunderstorms associated with gale-force winds

Table 3.--Maximum windspeed reported on Lake Ontario for each month by National Weather Service cooperating vessels, 1974

Month	Kn	Direction	Time (GMT)	Date	Ship	Latitude (°N)	Longitude (°W)
January					(No observations received)		
February					(No observations received)		
March					(No observations received)		
April	12	270°	0600	27	LEHIGH	43.7	77.4
May	20	210°	1800	31	LEHIGH	43.5	78.9
June	14	260°	0000	2	LEHIGH	43.8	77.2
July	20	010°	1200	16	LEHIGH	43.6	77.6
August	13	200°	0600	16	LEHIGH	43.6	77.9
September	38	280°	0000	30	LEON FALK, JR.	43.3	79.3
October	30	220°	1200	22	LEHIGH	43.8	76.8
November	24	050°	1800	5	ARTHUR M. ANDERSON	43.8	77.2
December	28	120°	0600	1	BENJAMIN F. FAIRLESS	43.6	78.1
Year	38	280°	0000	September 30	LEON FALK, JR.	43.3	79.3

in the synoptic reports. Of the 405 observations with winds greater than 30 kn, only 4 reported a thunderstorm occurring at the time of the observation. There were three reports of squalls, one during the past hour, and one in past weather, for a total of nine. Another statistic was the large number of observations with the visibility below 2 mi. The largest number were in June and July, with 158 and 135, respectively. This was approximately 10 and 9 percent of the total observations for those months. Ice accretion does not appear to be a problem as 3 in was the maximum reported. During January, one ship reported being stuck in the ice in Green Bay, and, during April, another was anchored in the ice field in Whitefish Bay.

High lake levels continued and contributed to flooding and erosion (fig. 13).

The following paragraphs describe by month some of the more severe storms that affected the Lakes this year. February and March are generally not included because of the lack of a significant number of observations.

Figure 13.--Ice, winds, and high lake levels combine to damage cottages on Lake Michigan. Wide World Photo.

Table 4.--Maximum windspeed reported on Lake Erie for each month by National Weather Service cooperating vessels, 1974

Month	Kn	Direction	Time (GMT)	Date	Ship	Latitude (°N)	Longitude (°W)
January	27	150°	0600	9	JOHN SHERWIN	41.5	81.7
February	14	350°	1800	1	ROGER BLOUGH	41.9	81.5
March				(No observations received)			
April	30	050°	1200	8	WILLIAM A. IRWIN	41.9	81.9
May	30	290°	1200	13	LEHIGH	41.9	82.8
June	38	280°	0600	11	LEON FALK, JR.	41.9	82.7
July	28	340°	1800	2	BENJAMIN F. FAIRLESS	41.9	81.5
August	33	240°	0600	5	IRVING S. OLDS	41.9	81.0
September	36	300°	0000	30	ASHLAND	41.7	82.5
October	32	340°	0600	2	CLIFFS VICTORY	42.2	81.1
		190°	1200	14	CHARLES M. WHITE	41.9	81.3
November	46	240°	0000	16	LEON FALK, JR.	41.6	82.3
December	48	060°	1800	1	CHARLES M. WHITE	41.7	82.0
				December			
Year	48	060°	1800	1	CHARLES M. WHITE	41.7	82.0

Table 5.--Maximum windspeed reported on Lake Huron for each month by National Weather Service cooperating vessels, 1974

Month	Kn	Direction	Time (GMT)	Date	Ship	Latitude (°N)	Longitude (°W)
January	33	260°	1800	4	BENJAMIN F. FAIRLESS	45.7	83.6
February	32	070°	1800	2	ROGER BLOUGH	45.3	82.1
March				(No observations received)			
April	40	290°	0600	15	GEORGE D. GOBLE	44.7	83.1
May	37	260°	1800	23	PAUL H. CARNAHAN	43.3	82.4
June	33	310°	1200	11	WILLIAM P. SNYDER, JR.	45.0	83.0
July	42	320°	1200	14	ERNEST R. BREECH	45.3	83.3
August	34	300°	1200	31	WILLIAM A. IRVIN	45.8	84.4
		350°	0000	14	ROGER BLOUGH	45.6	83.5
September	47	220°	1200	15	GEORGE D. GOBLE	44.3	82.9
October	40	280°	0600	7	ASHLAND	45.6	83.6
		270°	0600	7	JOHN DYKSTRA	44.4	82.9
November	42	350°	1200	21	J. L. MAUTHE	43.7	82.5
		340°	1800	21	J. L. MAUTHE	44.3	82.5
December	42	200°	0000	27	ASHLAND	44.6	82.9
		030°	1800	2	JOHN DYKSTRA	45.1	81.8
				September			
Year	47	220°	1200	15	GEORGE D. GOBLE	44.3	82.9

JANUARY

The Lakes had their share of storm centers this month. Five LOW centers passed over the Lakes, but generally these aren't the ones that bring the highest winds, at least not this year. The storm that resulted in the highest ship-reported wind came out of north-central Canada on the 4th. At 1800 on the 5th, the PAUL H. CARNAHAN had westerly 40-kn winds near the center of Lake Superior. At 0000 on the 6th, the 1008-mb center was near James Bay. At this time, the ARTHUR M. ANDERSON measured 44-kn winds from 280°, just north of Keweenaw Peninsula. This was the highest for the Lakes for the month. The CARNAHAN almost matched it with 43 kn, as she headed toward Duluth. By 1200 on the 6th, the LOW had dissipated over the Gulf of St. Lawrence.

Late on the 6th, another LOW developed over Lake Winnipeg and brushed Nipigon Bay on the north side of Lake Superior. At 0600 on the 7th, the ERNEST T. WEIR was headed into 40-kn westerly winds near the center of Lake Superior, with an air temperature of -13°C. At the same time, the ENDERS M. VOORHEES was north-northeast of Milwaukee with 35-kn winds and 4 cm of ice from spray. At 1200 on the 7th, the CARNAHAN was headed back eastward with 42-kn west-northwesterly winds.

This LOW moved almost due eastward from central Canada to James Bay, at 1200 on the 14th. At 0600, the LEON FRASER was near Stannard Rock with southerly winds of 37 kn. Six hours later, the ROGER BLOUGH had 39-kn westerly winds on western Lake Superior. At 1800, the FRASER was nearing the Apostle Islands with 42-kn gales. Duluth reported winds as high as 33 kn, Sault Ste. Marie 36 kn, and Buffalo had a peak gust of 54 kn from the southwest. The LOW was over Labrador by midday of the

Table 6.--Maximum windspeed reported on Lake Michigan for each month by National Weather Service cooperating vessels, 1974

Month	Kn	Direction	Time (GMT)	Date	Ship	Latitude (°N)	Longitude (°W)
January	36	190°	0000	14	ARTHUR M. ANDERSON	43.8	86.8
February	27	340°	1200	8	BENJAMIN F. FAIRLESS	42.4	87.2
March				(No observations received)			
April	32	360°	1800	23	JOHN SHERWIN	45.8	85.8
May	38	190°	1800	11	ARTHUR M. ANDERSON	42.3	87.3
		350°	0600	6	ROGER BLOUGH	43.5	86.7
June	39	010°	0000	23	WILLIAM A. IRVIN	42.4	87.2
July	39	210°	1200	2	ENDERS M. VOORHEES	45.3	86.3
August	36	280°	1200	31	ARTHUR M. ANDERSON	45.8	85.2
September	40	200°	1800	24	CASON J. CALLOWAY	45.3	86.6
October	40	330°	1200	17	WILLIAM A. IRVIN	45.9	85.3
November	34	350°	0600	21	ARMCO	45.9	85.5
		350°	0600	21	J. L. MAUTHE	45.9	85.5
December	42	220°	1800	26	CLIFFS VICTORY	45.7	85.7
Year	42	220°	1800	December 26	CLIFFS VICTORY	45.7	85.7

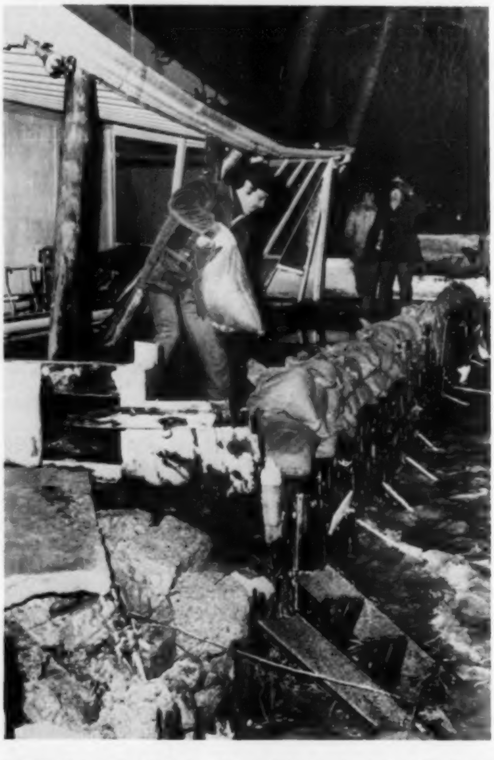


Figure 14.--Residents attempt to protect their cottage from high waters by sandbagging.

15th.

There were no high-wind reports from ships with this storm, but it was probably because most of the shipping had stopped by the 26th. A complex low-pressure and frontal system was approaching the Lakes on the 26th. That evening and night, they were hit by high winds and thunderstorms. There were gusts as high as 60 kn over Michigan and Ohio. Buffalo reported 57-kn gusts from the southwest. I found no indication of a seiche, probably due to an ice cover. Thunderstorms that far north, that late in the winter, are not a common occurrence. The southerly winds brought the highest temperatures of the month--mid-50's--to the Lake Superior area.

APRIL

The Great Lakes Basin was the favorite area for extratropical cyclones this month. The first ship report of winds over 30 kn was on the 12th, after the season got rolling. Prior to that, there was a storm center that moved over the Ohio River valley. As the LOW center moved south of Lake Erie, on the 8th, the northeasterly winds caused flooding on the Ohio and Michigan shorelines along the southwestern part of the Lakes. Winds of 30 to 40 kn were reported. In Monroe County, Mich., 200 families were evacuated, and 4 houses were destroyed, 90 damaged, and 500 flooded. Damage in Ohio was estimated at $750,000. The water level rose to 98 in above low water datum in Ohio, and 95 in above in Michigan (figs. 14 and 15). This was about 3-1/2 ft above the average lake level for the month, and 5-1/2 ft above the average level

Figure 15.--High waters from spring storm flooded many low-lying areas.

Table 7.--Maximum windspeed reported on Lake Superior for each month by National Weather Service cooperating vessels, 1974

Month	Kn	Direction	Time (GMT)	Date	Ship	Latitude (°N)	Longitude (°W)
January	44	280°	0000	6	ARTHUR M. ANDERSON	47.6	88.1
February	35	300°	0000	1	ENDERS M. VOORHEES	47.5	87.4
March				(No observations received)			
April	35	040°	0600	12	ENDERS M. VOORHEES	47.0	91.4
		050°	1800	15	FRANK ARMSTRONG	47.5	87.0
May	46	110°	1800	11	JOHN DYKSTRA	47.3	86.7
June	44	030°	1200	10	ASHLAND	47.5	88.6
July	35	260°	1800	27	ARTHUR M. ANDERSON	47.5	87.7
August	40	270°	0600	31	J. L. MAUTHE	47.4	89.2
September	40	010°	1200	29	JOHN SHERWIN	46.7	84.8
		350°	0600	13	EDMUND FITZGERALD	47.2	86.8
October	44	350°	1200	17	JOHN SHERWIN	46.7	84.8
November	38	260°	1800	15	J. L. MAUTHE	47.2	90.5
		020°	0600	24	ARTHUR M. ANDERSON	47.4	85.5
December	45	360°	0600	8	ERNEST R. BREECH	47.9	89.4
Year	46	110°	1800	May 11	JOHN DYKSTRA	47.3	86.7

for the last 10 yr. By the 9th, the LOW had moved far enough east for the winds to shift to the north, allowing the water to start receding.

This midmonth storm came out of the Oklahoma-Texas Panhandle, and the center moved over lower Lake Michigan and Lake Huron, on the 14th and 15th. The highest wind measured by a laker was 40 kn on Lake Huron, by the GEORGE D. GOBLE, at 0600 on the 15th. Twelve hours later, the FRANK ARMSTRONG found 35-kn gales on Lake Superior. Warnings were issued for flood and beach erosion from Cleveland to Buffalo, and gusts to 44 kn were reported.

This LOW crossed Lake Superior, early on the 22d. The higher winds were west of the center. At 0600 on the 23d, the ARMCO on Lake Superior experienced 35-kn northerly winds. Later in the day, the JOHN SHERWIN had 32-kn northerly winds on Lake Michigan. Lakeshore flooding and erosion (figs. 16 and 17) caused a cottage to fall into Lake Michigan near South Grand Haven.

Figure 16.--Erosion undermines cottage on Lake Michigan.

Figure 17.--Debris is all that remains of lakefront home.

MAY

The number of observations increased dramatically during May--almost three times as many as April. The Great Lakes Basin was once again the favorite area for storm tracks. There were 11 storm centers that passed over or near the Lakes, 2 of which were significant.

The first was a storm out of south-central Canada that moved north of Lake Superior, on the 2d and 3d. On the 1st, a HIGH was north of Lake Superior, and the LEON FRASER and GEORGE D. GOBLE were near the Straits of Mackinac with gales. As that center moved eastward followed by this 999-mb LOW, the wind shifted to the south. The CHARLES M. BEEGHLY on Lake Superior measured 40-kn winds and 13-ft seas. On the 3d, the wind veered to the northwest, and the GEORGE D. GOBLE had northwesterly winds of 33 kn on Lake Michigan.

The storm on the 11th and 12th was the most powerful. It came out of the Great Plains and moved o-

Table 8.--Maximum windspeed reported for each month for the Great Lakes by National Weather Service cooperating vessels, 1974

	Kn	Direction	Time (GMT)	Date	Lake	Ship	Latitude (°N)	Longitude (°W)
January	44	280°	0000	6	Superior	ARTHUR M. ANDERSON	47.6	88.1
February	35	300°	0000	1	Superior	ENDERS M. VOORHEES	47.5	87.4
March					(No observations received)			
April	40	290°	0600	15	Huron	GEORGE D. GOBLE	44.7	83.1
May	46	110°	1800	11	Superior	JOHN DYKSTRA	47.3	86.7
June	44	030°	1200	10	Superior	ASHLAND	47.5	88.6
July	42	320°	1200	14	Huron	ERNEST R. BREECH	45.3	83.3
August	40	270°	0600	31	Superior	J. L. MAUTHE	47.4	89.2
September	47	220°	1200	15	Huron	GEORGE D. GOBLE	44.3	82.9
October	44	350°	1200	17	Superior	JOHN SHERWIN	46.7	84.8
November	46	240°	0000	16	Erie	LEON FALK, JR.	41.6	82.3
December	48	060°	1800	1	Erie	CHARLES M. WHITE	41.7	82.0
Year	48	060°	1800	December 1	Erie	CHARLES M. WHITE	41.7	82.0

ver Lake Superior with a 990-mb center. The first indication of winds to come was by the CHAMPLAIN, at 0600 on the 11th, with 32-kn easterlies on Lake Superior. Twelve hours later, at 1800, there were five reports of strong winds. The highest for the month was by the JOHN DYKSTRA on Superior, with 46-kn east-southeasterlies, followed by: ARTHUR M. ANDERSON, 38 kn and visibility less than 150 ft on southern Lake Michigan; RESERVE, 38 kn; JOHN SHERWIN, 38 kn; and WILLIAM P. SNYDER, 32 kn, all on Lake Superior

JUNE

This month surpassed all others in the total number of observations, with 1,563. There were seven LOWs over or near the Great Lakes. The most severe occurred a third of the way through the month, on the 10th and 11th. The storm came out of Kansas and moved across the Straits of Mackinac. The ARCTIC TRADER radioed a report from Lake Erie, at 0000 on the 10th. The first strong-wind report, of 31 kn, was by the MIDDLETOWN on Lake Superior, at 0600 on the 10th. At 1200, the LOW was over upper Wisconsin, and the ASHLAND, south of Isle Royale, measured 44-kn north-northeasterly winds, the highest for this month. The seas were 15 ft. At the same time, the CHAMPLAIN and WILLIAM A. IRWIN experienced winds in the mid-30's speed range. Gale warnings were posted for Lakes Superior and Michigan. The storm moved northeastward, and, at 0600 of the 11th, the LEON FALK was on Lake Erie with 38-kn westerlies. As the LOW continued northeastward, the winds dropped below gale force.

On the 6th, a waterspout moving northeastward was sighted by the tug MUSKEGON, 14 mi off Kenosha.

The BENJAMIN F. FAIRLESS encountered the highest waves reported for the year on Lake Superior, on the 16th--16.5 ft. She was near the center of the lake with 30-kn northwesterly winds.

On the 23d, there was a single report of 39-kn winds out of the north, on lower Lake Michigan, by the WILLIAM A. IRWIN. A 998-mb LOW was moving eastward along the Ohio River.

On the last day of the month, a cold front moved across the Lakes. Immediately behind the front, the ENDERS M. VOORHEES on Lake Superior had northwesterly 34-kn winds. On the eastern end of Lake Erie, Buffalo recorded 28-kn southwesterly winds with 40-kn gusts. There were severe thunderstorms in the area, as Cleveland recorded gusts to 50 kn.

JULY

Only two cyclone centers passed over the Great Lakes. July ranked second below June in total observations--1,538--but had very few wind observations over 30 kn and, as would be suspected, very few high-wave reports. On the 2d, the LEON FALK sent a special observation at 0620, 30 mi south of Grand Marais. The wind was from the south-southwest at 52 kn, with heavy rain, thunder, lightning, and 6-ft waves building.

Of the nine reports of winds over 30 kn, four occurred on the 5th and were in the low 30's. A LOW moved over Lake Superior on the 4th. On the 5th, behind the LOW, minimum gales were reported on Lakes Huron, Michigan, and Superior, by the ERNEST R. BREECH, J. L. MAUTHE, and WILLIAM A. IRWIN.

The highest wind for the month was 42 kn by the ERNEST R. BREECH, on the 14th, on Lake Huron. A cold front was moving through the area about that time. Severe thunderstorms accompanied the front. Tornadoes touched down near Escanaba and Detroit, Mich. Gusts to 85 kn were measured at Escanaba, 61 kn near Chicago, and 52 kn near Detroit and Mount Clemens.

On the 22d, another waterspout was sighted over Lake Michigan, about 15 mi west-northwest of South Haven.

AUGUST

This was a very quiet month. The maximum wind barely made 40 kn, and that was on the last day. Two storms tracked over the Lakes. Again, as in many instances, the cyclone associated with the highest wind tracked north of the Lakes. The J. L. MAUTHE was on western Lake Superior behind the cold front, at

Table 9.--Highest 1-min wind (kn) reported on the Great Lakes by U.S. anemometer-equipped vessels

Year	Lake Erie		Lake Huron		Lake Michigan		Lake Superior		Lake Ontario	
1941	W	42	WSW	50	NW	43	NNW	54	--	--
1942	WSW	52	WSW	56	WNW	48	S	62	--	--
1943	WSW	57	WNW	43	SSW	50	WSW	52	--	--
1944	NE	38	NW	37	WSW	48	NNE	42	--	--
1945	WNW	52	SSW	54	WNW	49	NW	52	--	--
1946	SW	50	W	46	S	44	NW	47	--	--
1947	NW	51	SSE	43	ENE	39	WSW	43	--	--
1948	WSW	40	NNW	51	NW	45	WSW	48	--	--
1949	W	52	NNE	50	NNW	43	N	52	--	--
1950	SW	70	NW	48	NW	49	NW	81[1]	--	--
1951	WSW	37	WSW	50	SW	49	WSW	54	--	--
1952	SW	46	SW	57	SSW	44	WSW	45	--	--
1953	WSW	49	NW	45	NNW	46	ENE	50	--	--
1954	W	45	NW	45	E	48	N	43	--	--
1955	W	52	SW	57	WSW	58[1]	NW	48	--	--
1956	WSW	46	W	43	SSW	46	N	50	--	--
1957	WSW	72	SW	54	WSW	49	W	47	--	--
1958	SW	61	SW	43	SW	52	SSW	54	--	--
1959	W	42	NE	50	E	48	W	54	--	--
1960	NE	55	WSW	49	NW	55	N	54	--	--
1961	W	50	NW	47	NW	48	N	57	--	--
1962	NW	52	WNW	63	NW	48	NNW	60	--	--
1963	NNW	74[1]	NW	60	N	52	NNW	52	E	35
1964	WSW	68	W	72	NW	54	WSW	62	WNW	50[1]
1965	WSW	60	WNW	95[1]	ESE	52	SW	70	W	40
1966	ENE	49	NE	60	NW	57	NNE	61	W	39
1967	WSW	43	W	58	ENE	55	N	53	W	32
1968	W	63	NNW	44	WNW	46	NNE	55	SW	31
1969	WSW	44	NNW	46	NW	50	SSW	50	--	--
1970	W	52	W	62	NW	52	W	63	--	--
1971	SW	50	N	53	N	50	SW	56	--	--
1972	W	45	NW	56	N	54	NNE	60	--	--
1973	SW	45	ENE	44	NE	56	NE	50	--	--
1974	ENE	48	SW	47	SW	42	ESE	46	W	38

[1] Highest for each lake

0600 of the 31st, with 40-kn westerly winds. At that time, the ERNEST R. BREECH, near the middle of the lake, had 37-kn winds. The RESERVE, a few miles east of the MAUTHE, measured 34-kn winds, and the CHARLES M. BEEGHLY measured 32-kn gales on Lake Huron.

Thunderstorms appeared to be the major weather phenomenon this month from the charts and weather summaries, but none were reported as being associated with the wind reports of greater than 30 kn.

Traffic through the Welland Canal was blocked from the 25th through September 9, when the STEELTON rammed into the vertical-lift bridge at Port Robinson and completely demolished it (fig. 18), blocking the channel.

SEPTEMBER

The reports of winds greater than 30 kn increased several-fold this month. There were four storms that had their centers pass over the Lakes, and that many more tracked north of them. The vast majority of the high-wind reports by ships were during the last half of the month, but the highest was on the 15th.

There were reports of waterspouts on the 2d, 3d, and 21st, all on Lake Michigan. On the 3d, a 76-ft schooner had her rigging destroyed while 32 mi southeast of Milwaukee. The CHAMPLAIN included a report in the remarks section of two waterspouts over Lake Huron on the 5th.

This cyclone's center moved eastward north of the Lakes, from Lake Winnipeg, on the 14th and 15th. The high winds occurred, on the 15th, as the front moved across the Lakes, particularly on Lake Huron, but winds of gale force were measured on all the Lakes except Ontario. At 1200 on the 15th, the GEORGE D. GOBLE was headed northwestward toward Saginaw Bay with 47-kn winds from the southwest (220°). With the passage of the front, the winds shifted to the northwest, and the speed decreased rapidly.

On the 23d, a large HIGH dominated the eastern half of the Nation, and the center was moving along the Lower Lakes. As the HIGH moved eastward, a

Figure 18.--Traffic on the Welland Canal was blocked for about 2 wk by the Port Robinson Bridge, after the STEELTON rammed the structure. Photo courtesy of Great Lakes Commission.

LOW formed near the border, on the 24th, with frontogenesis. At 1200 and 1800, the CASON J. CALLOWAY was hit by 39- and 40-kn south-southwesterlies on northern Lake Michigan. The winds were the least of the CALLOWAY's worries, as she was headed into 18-ft waves at 1800 (fig. 19). These were the highest waves reported for the year, for all the Lakes. Gales continued to blow through 1800 on the 25th, when the ridge between this and the next cyclone moved over the area.

On the 29th, a cyclone center moved over Chicago and Lake Huron. The strong winds this time were behind, or west of, the center. The second strongest winds of the month, 42 kn, were found by the ERNEST R. BREECH on Lake Huron, at 1200, with continuous moderate rain. The JOHN SHERWIN had 40-kn northerly winds on Lake Superior. At 0000 on the 30th, the LEON FALK measured the only ship-reported wind of over 30 kn on Lake Ontario this year--38 kn from the west. The ASHLAND on Lake Erie had 36-kn northwesterlies. By midday on the 30th, the winds had decreased to below gale force.

OCTOBER

Eight cyclones tracked over or near the Great Lakes. The first significant LOW moved over Lakes Michigan and Huron on the 6th. The higher windspeeds were after the passage of the center, and over Lake Huron. At 0600, the ASHLAND and the JOHN DYKSTRA reported 40-kn westerly winds north of Saginaw Bay. The ENDERS M. VOORHEES, east of Milwaukee, had 34-kn northwesterly winds. The LOW was moving northeastward at 35 kn, so it did not affect the Lakes for long.

This was a complex LOW with an ill-defined center that moved eastward, brushing the northern shore of Lake Superior. The frontal system was oriented more east-west than north-south. The first gale winds were over Lake Superior, early on the 17th. At 1200, the JOHN SHERWIN was in Whitefish Bay fighting 44-kn northerly winds, the highest for the month. The WILLIAM A. IRWIN found 40-kn northwesterly winds on Lake Michigan. The ROGER BLOUGH, heading northwestward on Lake Superior, had 38-kn northerly winds for over 12 hr. The last gale report was on Lake Huron, early on the 18th.

The Great Lakes were between two large pressure systems, on the 21st and 22d. A 987-mb LOW was centered over northwestern Hudson Bay, and a 1039-mb HIGH was centered over North Carolina. The strongest winds were at 0000 on the 22d, with seven reports of winds greater than 30 kn. The ASHLAND measured the highest--40 kn--on Lake Superior, with 12-ft waves. The ERNEST R. BREECH also had 40-kn gales in the same area. The EDMUND FITZGERALD was on Lake Huron with 36-kn gales.

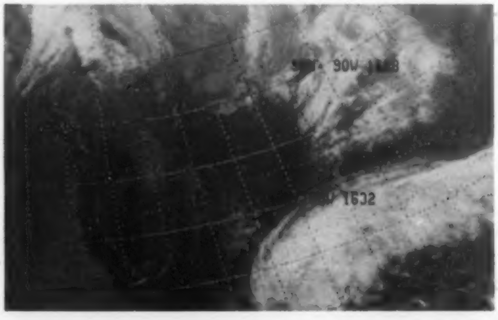


Figure 19.--NOAA-2 IR picture shows the storm, located just north of the Lakes, in which the CALLOWAY encountered the year's highest waves.

Table 10.--Highest seas reported on the Great Lakes by National Weather Service cooperating vessels, 1974

	Ship	Date	Height (ft)
Lake Ontario	LEHIGH	October 22	7
Lake Erie	CHARLES M. WHITE	December 1	15
Lake Huron	JOHN DYKSTRA	November 15	13
Lake Michigan	CASON J. CALLOWAY	September 24	18
Lake Superior	BENJAMIN F. FAIRLESS	June 16	16

NOVEMBER

The first half of the month, the storms approached the Great Lakes from the southwest, switching to westerly the third week, and northwesterly the last week, for a total of seven. Two of these accounted for the vast majority of the gale-force winds.

The first of these two storms, which resulted in the highest winds for the month, was actually a combination of three LOW centers that moved across the area, starting on the 11th. The major LOW center was over Hudson Strait, at 0000 on the 16th, when the LEON FALK fought with 46-kn gales on Lake Erie. A high-pressure center was over northern Alabama, but even though that center was closer, the isobars over the Lakes had cyclonic curvature. Ship reports for the 14th indicated only minimal gales on Lake Superior, but the Buffalo area recorded gusts as high as 56 kn. The lake level was 9.5 ft above normal there, and five cottages were destroyed by high waves on Hoover Beach.

During the 24-hr period, 0000 of the 15th to 0000 of the 16th, there were 23 reports of winds greater than 30 kn. The CLIFFS VICTORY reported 40-kn gales on Lake Erie, as did the JOHN DYKSTRA, on Lake Huron with the highest waves--13 ft. One-third of the reports were over Lake Huron. By 1200 on the 16th, the deep trough had moved eastward and was replaced by a minor ridge with lighter winds.

This storm formed near Fargo, N.D., as the combination of two small low-pressure centers. By 1200 on the 20th, the 995-mb center was over Lake Michigan with a large circulation, and for the next 24 hr, the winds blew. There were four reports of 40 kn or greater, two each on Lakes Erie and Huron. Storm warnings were posted for Lake Erie, with gale warnings for the remainder of the Lakes. Ten-foot waves were reported by cooperating ships. The CASON J. CALLOWAY and J. L. MAUTHE reported the higher winds. Other reports indicated 50-kn winds and 14-ft seas.

DECEMBER

Six extratropical cyclones tracked across the Great Lakes, but the most severe storm of the season, on the Lakes, moved northeastward up the U. S. east coast. The strongest sustained wind of the year was measured on Lake Erie by the CHARLES M. WHITE, at 1800 on the 1st--48 kn (fig. 20). The seas were 15 ft. The JENNIFER, a Canadian cargo ship, sank in Lake Michigan, about 38 mi from Milwaukee, early on the 1st. The cargo shifted, and she foundered. All of the crew were saved. (See page 95 of the March 1975 issue of the Mariners Weather Log.) The highest winds were on Lakes Erie and Huron. Storm warnings were posted for Lake Erie, and gale warnings were in effect for the other southern Lakes. Lakeshore flooding and erosion occurred on southwestern Lake Erie and southern Lake Michigan. There was a difference in the level of Lake Erie of nearly 8 ft, on the 1st, between Toledo and Buffalo, as shown on figure 21.

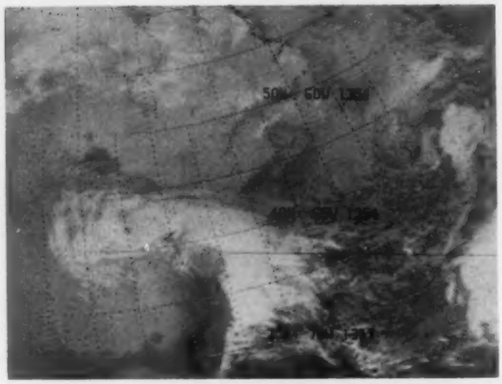


Figure 20.--A space view of the storm that produced the highest winds of the year and sank the JENNIFER.

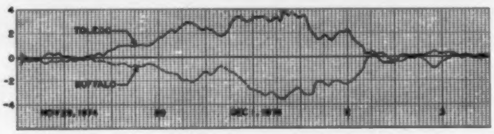


Figure 21.--The observed lake levels at opposite ends of Lake Erie. Heights are in feet from the monthly mean.

A storm that crossed the Great Lakes, on the 8th, resulted in five wind reports of 40 kn or greater on Lakes Superior and Michigan. The highest--45 kn--was measured by the ERNEST R. BREECH on Lake Superior, at 0600 of the 8th. The ASHLAND found 40-kn gales on Lake Michigan at 1200. By the 9th, the winds had decreased to below gale force.

Cyclones passed over the area on the 16th and 17th, and the 23d, and north of the basin on the 26th and 27th, and the 31st. All produced some gale-force winds.

Two ships collided head-on in fog on the St. Clair River, early on the morning of the 11th. They were the American freighter H. LEE WHITE, upbound, and the Greek bulk carrier GEORGIOS A. Four days earlier, on the 8th, two American freighters collided near Detroit, while passing on Lake St. Clair. They were the MERLE M. MCCURDY and the PHILIP R. CLARKE.

ACKNOWLEDGEMENTS

The first thanks must go to the masters and mates aboard the cooperating Great Lakes vessels, for their valuable observations and contributions to the National Weather Service observing program. Much useful information and photographs were obtained from Albert G. Ballert and the Great Lakes News Letter of the Great Lakes Commission. National Weather Service meteorological and ice data were provided by Daron E. Boyce, of the Ice Navigation Center.

Of primary importance were the listings of wind, wave, visibility, and ice data supplied by the Environmental Data Service's National Climatic Center, Asheville, N.C., on which much of the article is based.

Hints to the Observer

HURRICANE REPORTING

Dear Captain:

I'd like to remind you that the hurricane season (June through November) is near. In order for us to provide adequate warnings, it is essential that we receive as much information as possible from ships encountering evidence of hurricanes.

To assist our forecasters in determining storm location, intensity, and movement, we would like you to:

1. Make and transmit reports at least at 3-hr intervals when within 300 mi of a tropical storm or hurricane.

2. Include in "Remarks" the lowest pressure and/or the highest wind encountered if, since the last synoptic report:

   a. The pressure was more than 5 mb lower, and/or

   b. The wind was more than 15 kn higher than the present value(s).

   Also, include the time of occurrence.

   Example: 0800Z LOWEST PRESSURE 970MB 0730Z HIGHEST WIND 85KN.

I've enclosed copies of "General Instructions for Radio Reporting of Weather Observations" for your use.

The National Weather Service appreciates the time and effort you and your officers give to provide reports of weather conditions at sea. Your reports are extremely important considering the vast ocean spaces and the relatively few ships that report weather.

Sincerely,

George P. Cressman
Director, National Weather Service

GENERAL INSTRUCTIONS FOR RADIO REPORTING OF WEATHER OBSERVATIONS

Standard Synoptic Observation Times--The regular weather-reporting hours are 0000, 0600, 1200, and 1800 GMT. Occasionally, watch schedules or priority of other duties make it impractical to make and transmit surface observations at standard synoptic times. To ensure message transmission, observations may be made in advance of the weather-reporting hours. In these cases, the actual time of observation should be included in the report.

Coded Weather Messages--All messages to be transmitted by radio should be transcribed from the ship's weather log to NOAA Form 72-4, "Weather Report for Immediate Radio Transmission," in the ship synoptic code FM21E and given to the Radio Officer.

Transmission of Radio Messages--Weather messages should be transmitted as soon as possible to the most convenient radio station in accordance with instructions contained in United States and Foreign Coastal Radio Stations Accepting Ships' Weather Observation Messages.

If a message cannot be transmitted within 3 hr after a standard time, no further attempt should be made unless the observation was made in the Southern Hemisphere or reflects severe weather conditions not included in the latest forecasts. Observations delayed more than 12 hr should not be transmitted in any case.

Worldwide Weather Reporting--You are urged to contribute to this World Meteorological Organization (WMO) program by transmitting weather reports to national meteorological services responsible for collecting ship observations in all parts of the world. Addresses for transmissions are contained in United States and Foreign Coastal Radio Stations Accepting Ships' Weather Observation Messages.

Weather Message Addresses for Transmission to U.S. Radio Stations--Use "OBS METEO WASHDC" when in the:

1. Western North Atlantic, including the Gulf of Mexico and Caribbean Sea, north of 3°N latitude, and west of 35°W longitude (WMO Region IV-A).
2. Eastern North Pacific (north of the Equator), east of the 180th meridian (WMO Region IV-A).
3. Eastern South Pacific (south of the Equator), from the South American coast to 120°W longitude (WMO Region III-B).

Use "OBS METEO GUAM" when in the western North Pacific between 5° and 25°N latitude, and from 135°E to the 180th meridian (WMO GUAM ZONE).

Observations During Storm Conditions--Whenever TROPICAL STORM, TYPHOON, or HURRICANE conditions are encountered anywhere, "SAFETY OF LIFE AT SEA CONVENTION," Chapter V, requires all ships to take a special observation and transmit the report to the closest national meteorological service via the most convenient radio station. In addition to this requirement, it is highly desirable that weather reports be transmitted hourly if possible, but, in any case, not less frequently than every 3 hr.

Special Requests for Observations--During storm situations, the U. S. National Weather Service may request ships located in areas of suspected storm development to take special observations at more frequent intervals than the routine 6-hr synoptic observation times. If your ship happens to be in such an area, your report will be helpful even though conditions may not appear bad enough to warrant a special observation. To speed delivery of messages from storm areas and to identify them as such, the word STORM should appear immediately following the radio address. These messages should be addressed to the requesting forecast office. For example, "OBS METEO NEW YORK STORM 99305 70750," etc., would be used if the New York Forecast Office requested the observation.

Observations in Coastal Waters--Since radio weather reports are always needed from ships in coastal waters, observations should continue to be taken as close to shore as ship routine permits.

Tips to the Radio Officer

Warren D. Hight
National Weather Service, NOAA
Silver Spring, Md.

CORRECTIONS TO 1974 EDITION OF RADIO STATIONS ACCEPTING SHIPS' WEATHER OBSERVATIONS

Page 18--Simonstown, South Africa (ZSJ): Mr. C.H. E.J. van der Ploeg, RO, on the NEDLLOYD KEMBLA, reported that in December this station refused to accept his ship's weather messages, and will accept only AMVER messages.

Page 19--Djibouti, Afars and Issa (TXZ): Mr. P. Martin, RO, on the PATONGA, reported in January that he had difficulty getting this station to accept his weather messages.

COMMENT ON ADDRESSING WEATHER MESSAGES

Recently a radio officer advised us that the Naval Communications Station, Guam, could not relay messages addressed to "METEO TOKYO." The following might help to clarify the instructions in the booklet, Radio Stations Accepting Ships' Weather Observations. It is important that the radio officer address the message to the specific address shown for each radio station in the book. In other words, for each radio station there is a corresponding meteorological address. In the case of Radio NRV, Guam, the proper address is "METEO GUAM." (See pages 14 and 15.) There are instances where several radio stations in a particular country have the same meteorological address; rather than repeat the address for each station, the address is given only once, following the name of the country. Good examples of this are Japan on page 13, and the United States on pages 5 and 7, where only one address is specified.

Occasionally, a mate encoding his weather observation on NOAA Form 72-4 might fill in what he believes to be the proper address. In such cases, the radio officer should ignore it, because only he can determine the address, and then only after he knows what radio station will accept the message.

CORRECTIONS TO PUBLICATION, WORLDWIDE MARINE WEATHER BROADCASTS

Page 6--Frobisher, N.W.T., Canada (VFF): Opposite A1 frequencies, change times of broadcast to read "0200, 1100, 1400, 2300."

Page 8--Grindstone, Quebec, Canada (VCN): Change times of A3 and F3 broadcasts to read "0410, 0930, 1730, and 2215."

Page 35--Delete details for Gibraltar (ZDK).

Page 71--Singapore (9VG): Change class of emission of 0145 and 1345 broadcasts from "A2" to "A3."

ACKNOWLEDGEMENT OF CORRESPONDENCE

The National Weather Service would like to thank everyone who responded to our inquiry included with the Radio NAM marine weather broadcast. All comments are being evaluated, and more information will be forthcoming.

WE OF NOAA ARE MAKING USE OF THIS SMALL AMOUNT OF SPACE TO EXTEND OUR THANKS TO ALL THE SHIPS' OFFICERS WHO ROUTINELY TAKE SHIPBOARD WEATHER OBSERVATIONS. TO US. THESE EXCELLENT OBSERVATIONS ARE PRICELESS. WE CERTAINLY DO APPRECIATE RECEIVING THEM ON A REGULAR BASIS.

Hurricane Alley

Dick DeAngelis
Environmental Data Service, NOAA
Washington, D.C.

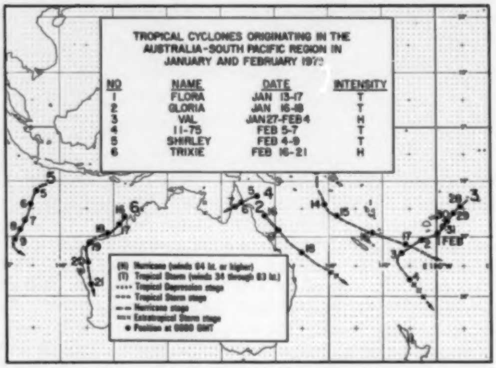


Figure 22.--Tropical cyclones originating in the Australia-South Pacific region, in January and February 1975.

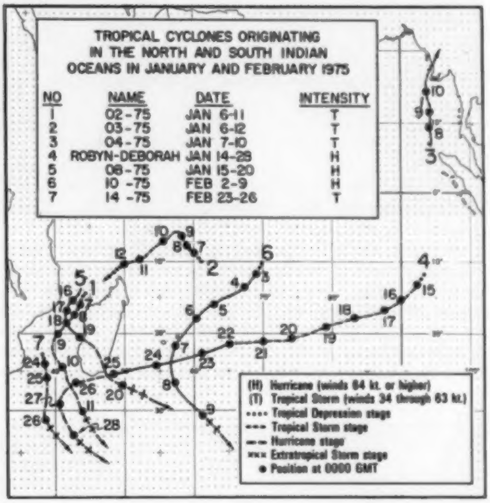


Figure 23.--Tropical cyclones in the North and South Indian Oceans, in January and February 1975.

Across the broad expanse of tropical Southern Hemisphere waters from the east coast of Africa to the Cook Islands, January and February spell danger to mariners sailing these seas. More than one-half of all Southern Hemisphere tropical cyclones occur during these two months. Four hurricanes roam these waters in an average January and February.

Val, Trixie, and Robyn-Deborah were among the January-February hurricanes of 1975. Trixie was one of the most severe storms ever to hit Western Australia. Val clobbered Samoa and the Fiji Islands, while Robyn-Deborah threatened South Indian Ocean shipping for 2 wk.

The tropical cyclone tracks, figs. 22 and 23, are preliminary and based on satellite information provided by NESS. The Bureau of Meteorology of Australia supplied a track and summary for Trixie. They also reported that the highest gust recorded in Tracy (see "Hurricane Alley," March 1975) has been changed to 117 kn, after the discovery of an anemometer-recording malfunction at Darwin. However, there is evidence of stronger gusts following the eye passage at Darwin. Mr. Anfinson, Meteorologist-in-Charge on Fiji, was kind enough to provide some details on hurricane Val.

SOUTH PACIFIC-AUSTRALIA REGION

The three January cyclones all developed east of Australia. In February, two tropical cyclones developed west of the continent, while one flared up briefly near the Cape York Peninsula. On the average, about six tropical storms and two hurricanes form during this period.

This February, severe cyclone Trixie brought 100-kn winds to the northwest coast of Western Australia. Her torrential rains spread inland, triggering floods in the mountainous regions.

Western Australia is plagued and blessed with tropical cyclones almost every year; plagued by the winds and floods and blessed by the rains, which are often beneficial to the farming regions. Most of the people live along the coast, and three-fourths of the population is presently centered in Perth. However, this is rapidly changing. Western Australia is a true boom area. Iron and nickel mines and offshore oil and gas are partly responsible for the new towns that are springing up both along the coast and inland. The expansion along the northwest coast will increase the destruction done by tropical cyclones.

Trixie formed, on the 15th, about 70 mi north of Broome, the Kimberly region's southern port and most exotic town. Intensifying, she moved southwestward, dumping rain over the Great Sandy Desert, which extends almost to the sea southwest of Broome. By the 18th, Trixie was nearing hurricane proportions. Gales extended westward 400 mi across the South Indian Ocean and eastward 150 mi over the rust-red, iron-filled mountains of the Pilbara region. Port Headland, one of the boom towns whose population has increased tenfold in the past 8 yr, was lashed by 67-kn gusts and suffered minor damage. A tug sheltering in the Flying Foam Passage reported a 958-mb pressure as Trixie approached the new port of Dampier. This town, built by the Hamersley Iron complex to handle shiploading, suffered damage estimated at $2

million (Australian dollars). Sustained winds near Trixie's center, which passed within about 20 mi of Dampier, were estimated at about 60 kn. A few hours later, she was a hurricane. It was estimated that 100-kn winds blew around her 930-mb center shortly before Trixie crashed ashore near the small town of Onslow. The wind at Onslow caused considerable damage. Among other things, it blew the roof off the weather office, making the rain-soaked weather records difficult to interpret. It is believed that sustained winds reached 75 kn, with gusts to 133 kn, at 1005 on the 19th. A few hours before, the pressure had dipped to 955 mb. The wind records are presently being reevaluated. If this wind holds up, Trixie will stand as Australia's most intense cyclone on record.

Once inland, Trixie's winds diminished rapidly, but she spread heavy rains over the mountain areas to the east and farming areas to the west. Moving southward, she passed about 60 mi to the east of Carnarvon, on the 20th (fig. 24), leaving the pioneer country and entering civilization. The heavy rains triggered flooding over the mountainous regions of Gascoyne, Murchison, and the northeast Gold Fields, but brought relief to rain-short farming areas. The storm finally broke up on the 21st, over the wheatlands west of Geraldton, a grain and fishery center of some 19,000 people.

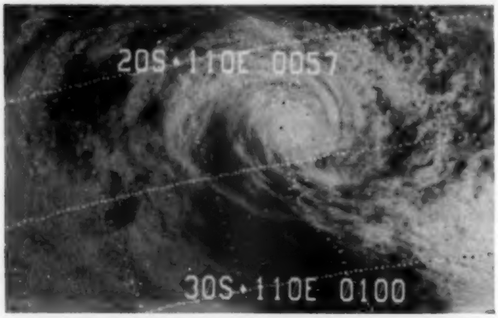


Figure 24.--Trixie trips out over Western Australia on the 20th.

Hurricane Val came to life in late January just west of the Samoa Islands. Moving slowly southwestward, she became a hurricane on the 30th, as winds near her eye climbed to 70 kn (fig. 25). By the 1st, these winds were at least 120 kn, with a central pressure below 940 mb. At Vunisea (108 ft) in the Fiji Islands, they were blowing in excess of 80 kn. Val caused widespread damage on the islands of the Lau Group, but, because warnings were issued in ample time, there was no loss of life, and no ships or boats were lost. The potent hurricane recurved southeastward on the 3d. This marked her downfall, as she began to turn extratropical. Around the middle of the month, Flora blossomed just south of the Solomon Islands, while Gloria took shape along the Great Barrier Reef, southeast of Cape Melville. Flora was the more potent of the two. She peaked on the 15th, when winds near her center reached 50 kn, and gales extended out 80 mi in all directions. Gloria was a minimal tropical storm for most of her existence. Pine Islet (190 ft), about 180 mi south of Gloria's center, was brushed by 35-kn winds on the 17th. Flora fizzled that day, while Gloria turned extratropical the following day.

Figure 25.--Hurricane Val blankets the Fiji Islands, on her southwestward on the 9th.

In early February, storms broke out east and west of Australia. Shirley popped up near Christmas Island on the 4th, while an unnamed storm (11-75) was detected just east of the Cape York Peninsula. Winds around Shirley reached 40 to 45 kn as she moved south-southwestward. By the 9th, she was extratropical. The other storm reached tropical storm strength before moving ashore near Cape Melville. She dissipated over the Peninsula and did not reform in the Gulf of Carpentaria as expected.

SOUTH INDIAN OCEAN

Four tropical cyclones formed in January, and two in February. Three storms disrupted shipping in the Mozambique Channel. Three reached hurricane intensity. An average of four tropical storms and two hurricanes usually develop during January and February.

The Mozambique Channel was under the influence of a tropical storm and a hurricane in January, and a late February tropical storm. The first storm moved through the Channel from the 7th to the 11th. Maximum winds reached 50 kn, on the 10th, before it weakened and turned extratropical. The hurricane developed on the 16th. It was actually a redevelopment of a tropical storm that had formed on the 7th southeast of the Seychelles and had moved to the northern tip of the Malagasy Republic before it had become disorganized. The hurricane moved southeastward over the Malagasy Republic, near Morondava, on the 19th. Its winds had peaked at about 70 kn on the 18th (fig. 26).

Figure 26.--A Mozambique Channel hurricane peaking on the 18th.

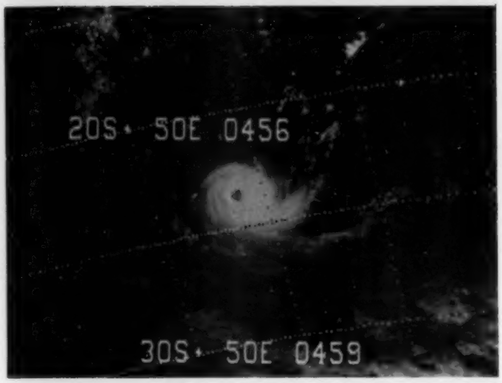


Figure 27.--Sporting winds of 100 kn plus, Robyn becomes Deborah on the 24th.

Figure 28.--Mauritius and Reunion are blanketed by the circulation of this intense hurricane on the 7th.

The third storm to affect the Channel developed in the southern part on February 23. It was a tropical storm for 2 days as it moved southward into open waters.

The longest-lived storm of the period was hurricane Robyn-Deborah. She began just west of Cocos Island, on the 14th, and turned extratropical well south of the Malagasy Republic, 2 wk later. During that period, the storm moved on a mostly west-southwesterly track. She became a hurricane on the 22d and remained one until the 25th. On the 23d, maximum sustained winds were estimated at more than 100 kn near her center, and gales extended out more than 100 mi in all directions. Robyn became Deborah on the 24th (fig. 27), as she moved into the Mauritius area.

The most intense storm of the 2-mo period developed on February 2, and moved through the Reunion-Mauritius area on the 6th and 7th (fig. 28). It was of hurricane intensity from the 5th through the 8th. During the time she affected the islands, winds near her center were estimated at over 110 kn, and gales extended out to 180 mi. On the 9th, the still-potent storm was turning extratropical as she headed for the open seas.

NORTH INDIAN OCEAN

January storms are uncommon in these waters, but one did develop this year. It developed on the 7th over the Nicobar Islands just north of Sumatra. The storm moved northward through the western Andaman Sea, as winds near its center remained at minimal tropical storm strength. On the 10th, the storm, now a depression, came ashore over southwestern Burma.

On the Editor's Desk

SEAWAY OPENING IS EARLIEST YET

The Montreal-Lake Ontario Section of the St. Lawrence Seaway was opened to commercial traffic on March 23, marking the earliest shipping season inaugural since the deep-draft waterway was completed in 1959.

The first upbound vessel to pass through the St. Lambert was the Canadian RICHELIEU, a 730-ft-long laker, hauling 24,800 tons of iron ore from the lower St. Lawrence to Hamilton, Ont. Ready to move upbound through the Seaway immediately behind the RICHELIEU were, in sequence, the BAIE ST. PAUL, ESKIMO, CANADIAN MARINER, JOS. SIMARD, and the J.N. MCWATTERS.

Transit of both upbound and downbound ships through the seven-lock system reportedly was delayed by fog. As of the afternoon of the 23d, there were eight downbound vessels tied up at Prescott, Ont., waiting to enter the Iroquois Lock, the westernmost lock in the Montreal-Lake Ontario Section. The first of these was the LAKE WINNIPEG, a 730-ft-long laker, loaded with barley and destined for Baiecomeau, Que. The other seven vessels waiting to enter the Iroquois Lock on the Seaway's first day of operation were, in order, the CAROL LAKE, CANADIAN LEADER, HILDA MARJANNE, MENIHEK LAKE, LAKE MANITOBA, RED WING, and the KINGDOC.

There was some ice in Lake St. Francis and above the Eisenhower Lock, but no problems were anticipated.

It was also noted that, as of the morning of the 23d, buoys on the U.S.-controlled section of the Seaway were in place only from the Eisenhower to the Iroquois Locks, with the channel between the latter and Lake Ontario scheduled to have its buoys repositioned by the end of the week. Until that time, the U.S. section would be open only to daylight navigation.

PILOT DRIFTING BUOY EXPERIMENT PLANNED IN SOUTHERN OCEAN

The plans for the First GARP (Global Atmospheric Research Program) Global Experiment (FGGE) presently include an array of expendable drifting buoys in

the Southern Ocean to provide key reference-level information on atmospheric pressure and sea-surface temperature.

In the early planning stages, emphasis was placed on a latitude band between 50° and 65°S, but recent numerical studies have focused on the need for drifters at latitudes as low as 20°S, during each of the FGGE Special Observing Periods.

United States scientists interested in this drifter deployment met in April 1974 and recommended that a pilot scientific/engineering program be initiated to test a developed drifting buoy and satellite system, and to determine, as far as possible, the Lagrangian characteristics of the currents in the Southern Ocean. Subsequently, in cooperation with scientists in South Africa and Australia, the United States initiated a FGGE Pilot Drifter Project. This program will employ a number of free-drifting buoys equipped with a communications capability compatible with the NIMBUS-F satellite system. Plans are for the deployment of buoys to take place in January and February of 1976, with overall management of the program under the direction of the NOAA Data Buoy Office.

It is recognized that the Southern Ocean, because of generally severe environmental conditions, is not an optimum location in which to investigate the effectiveness of Lagrangian current measurement techniques; however, observations on the performance of drogued drifters in Antarctic circumpolar waters are needed to evaluate whether useful oceanographic information can be obtained with this technique. These system trials will also include dispersion experiments from clusters and lines of buoys. These tests will provide an indication of the degree to which the drift of an individual buoy is representative of the movement of the surface and near-surface water of the ocean, and the tendency for clustering in an initially uniform distribution. By taking into account the results of the experiments, it should be possible to refine present hypothetical forecasts of the drift of buoys deployed by ship in the experimental regions. An attempt will be made to retrieve one or more of the drifting buoys for evaluation after an adequate period of operation.

A total of 23 drifting buoys will be deployed during the experiment. Three buoys will be supplied by South Africa, and an additional number may be supplied by Australia. The experiment will be performed in three major regions along New Zealand, Drake Passage, and South African legs to the Antarctic. Six of the drifting buoys funded by the National Science Foundation will be deployed in the Drake Passage, in conjunction with an International Southern Ocean Study field project in that region.

The buoy system consists of a 4-m, surface-following spar, equipped with satellite (NIMBUS-F) communications and position-fixing capability, and a window shade-type drogue at a depth of 30 m. The buoys will be outfitted with windspeed, atmospheric pressure, and sea-surface temperature sensors. For engineering purposes, a tensiometer on the drogue line and a battery voltage sensor will also be monitored. Each buoy/drogue system is packaged individually in a crate and can readily be deployed from a research vessel without specialized equipment.

ON ADDRESSING SHIPS' WEATHER MESSAGES

Mates who take weather observations should read the article in "Tips to the Radio Officer" regarding addressing of weather messages. Note that the radio officer determines the radio address of the meteorological center, since it depends entirely on which radio station accepts the message.

COAST GUARD RADIOTELEPHONE COLLECTION OF SIMPLIFIED CODED WEATHER MESSAGES IS PROMISING

The National Weather Service is encouraged by the response to the new Coast Guard program for accepting coded weather reports on radiotelephone frequencies by its stations at Washington, D. C., New Orleans, San Francisco, Honolulu, and Kodiak. The messages typically are from small vessels that ply waters near shore, where the number of ship weather reports is usually insufficient.

A table of working frequencies for these stations was printed in the November 1974 and March 1975 issues of this publication.

NEW ASSISTANT PORT METEOROLOGICAL OFFICER AT NEW YORK CITY

Deck officers on cooperative weather-observing ships entering the Port of New York will find a new weatherman coming aboard. Mr. Robert Baskerville has been designated Assistant Port Meteorological Officer at the National Weather Service Office in New York City (fig. 29).

Bob received his initial weather training during a 4-yr stint in the U. S. Air Force. In 1960, he joined the U. S. Weather Bureau in New York. He attended several private universities and received certification as a Radar Weather Specialist at the Weather Radar School in Miami, Fla. Among his other accomplishments is a fine record of achievement with the National Weather Service which includes several awards for outstanding performance.

Figure 29.--Mr. Robert Baskerville, the new Assistant Port Meteorological Officer for New York Harbor.

NOAA TO INSPECT MARINE NAVIGATIONAL FACILITIES FROM CAPE HENRY, VA., TO KEY WEST, FLA.

A 4-mo inspection of marine and navigational facilities from Cape Henry, Va., to Key West, Fla., will be conducted for a new edition of the Coast Pilot for that area. The Coast Pilot, a publication issued by NOAA's National Ocean Survey, contains important navigational information which can not be shown graphically on the nautical charts, including details con-

cerning waterways, harbors, anchorages, navigation regulations, weather, marine and port facilities, routes, and prominent landmarks.

The inspector, Lt. (j.g.) Pamela R. Chelgren, will meet with officials of Federal, State, and local marine navigation agencies, including Coast Guard and Navy personnel, port authorities, harbormasters, merchant seamen, pilots, and others involved in marine affairs and regulations. She will also examine marinas and their facilities; question the Army Corps of Engineers concerning plans for deepening channels; confer with Customs, Immigration and Naturalization, and Public Health officials regarding regulations and inspection requirements; and talk to port authorities on such varied subjects of interest to mariners as the depth of water at piers and regulations concerning anchorages.

Inspections are conducted about every 5 yr to update the eight Coast Pilot publications.

Between 1885 and 1889, four local Coast Pilots were published covering the Atlantic Coast from Cape Henry to Key West. The first complete edition of the area was published in 1895. Since then, 15 additional editions have been published, the most recent in 1970.

CLOSE CALL FOR USCG ICEBREAKER GLACIER

The U. S. Coast Guard Icebreaker GLACIER (fig. 30) was beset in Antarctica sea ice March 5 after damaging one of its two propellers. The GLACIER was steaming to the aid of an Argentine Navy icebreaker which was wedged in the ice near the northern tip of the Palmer Peninsula.

The 211-man crew of the 310-ft Coast Guard ship, including 3 Naval Sea Cadets and 8 civilian scientists, was in no danger. All of the GLACIER's heating and lighting systems were working, and there were enough provisions on board for a full crew for several months.

GLACIER became beset in the ice when it and the Coast Guard Icebreaker BURTON ISLAND responded to a request to assist the Argentine Navy Icebreaker GENERAL SAN MARTIN. GENERAL SAN MARTIN had become wedged between large floes of ice after it began having engine problems while resupplying Argentine research bases located on the eastern side of the Palmer Peninsula.

When the two Coast Guard icebreakers arrived on the scene, the GLACIER, the more powerful and the largest U. S. icebreaker in service, began to break its way to the stranded 279-ft Argentine ship. After

Figure 30.--USCG Icebreaker GLACIER opening a channel to McMurdo Sound during Operation Deep Freeze, last July. U.S. Coast Guard Photo.

several hours of icebreaking, the Commanding Officer of the GLACIER noticed a slow rocking vibration in the shafts. The ship was immediately stopped, and a diver was sent to investigate the possible cause. The investigation revealed that two blades on the GLACIER's starboard propeller had been sheared off by the steel-hard, multiyear ice.

The GLACIER was separated from the open waters of the Weddell Sea by 12 mi of ice, up to 25 ft thick. On March 11, the icebreaker radioed that she had backed and rammed her way to the open sea using only one propeller. In the meantime, the GENERAL SAN MARTIN had also made it to the open sea.

GLACIER was steaming for its home port of Long Beach, Calif., when it was called on for this final assignment. The ship has been deployed since November 1974, supporting the National Science Foundation's "Deep Freeze" operations.

NAMES FOR TROPICAL CYCLONES, 1975

The following lists of names are those that will be assigned to tropical cyclones that reach tropical storm or greater intensity during calendar year 1975. A new list is started each calendar year for tropical cyclones of the eastern North Pacific (Central American west coast to 140°W) and of the North Atlantic, including the Caribbean Sea and the Gulf of Mexico. For the western North Pacific (140°W to the Asiatic mainland), the practice of continuing the alphabet from the previous year remains unchanged.

Atlantic	Eastern Pacific	Western Pacific	
Amy	Agatha	Lola	Lorna
Blanche	Bridget	Mamie	Marie
Caroline	Carlotta	Nina	Nancy
Doris	Denise	Ora	Olga
Eloise	Eleanor	Phyllis	Pamela
Faye	Francene	Rita	Ruby
Gladys	Georgette	Susan	Sally
Hallie	Hilary	Tess	Therese
Ingrid	Ilsa	Viola	Violet
Julia	Jewel	Winnie	Wilda
Kitty	Katrina	Alice	Anita
Lilly	Lily	Betty	Billie
Mabel	Monica	Cora	Clara
Niki	Nanette	Doris	Dot
Opal	Olivia	Elsie	Ellen
Peggy	Priscilla	Flossie	Fran
Ruby	Ramona	Grace	Georgia
Sheila	Sharon	Helen	Hope
Tilda	Terry	Ida	Iris
Vicky	Veronica	June	Joan
Winnie	Winifred	Kathy	Kate

DEEP OCEAN WEATHER-REPORTING BUOY TO BECOME OPERATIONAL THIS YEAR

Five years of work in the development of deep ocean-moored buoys that automatically supply environmental data for improved weather forecasting will culminate in mid-1975 with the deployment of a prototype operational environmental buoy in the Gulf of Alaska. The 60-ton, 33-ft (10-m) discus prototype buoy will be delivered to the NOAA Data Buoy Office. It will become the forerunner of a series of operational buoys that will be deployed off the coasts of the United States to furnish environmental data from storm-spawning ocean areas to the meteorological community.

The automatic environmental data buoy is a complementary system to many types of platforms, including satellites, aircraft, SHIPS, and fixed platforms, each with its own advantages and limitations. Through the use of advanced technology, the data buoy is now well suited for the acquisition of marine environmental data. It is the culmination of a systematic approach to the development of a data acquisition system capable of surviving severe weather in deep ocean areas and providing real-time information to aid weather-forecasting and storm-warning activities.

The prototype buoy will have meteorological sensors mounted at the 33-ft elevation, a nylon mooring line, a 3-yr supply of air-depolarized batteries, and a low-powered, modularized electronics payload. The payload will include meteorological sensor assemblies to measure windspeed and direction, barometric pressure, and air temperature, and thermistors to measure water temperature at seven levels. The buoy is designed to withstand 150-kn winds, 60-ft waves, and 6-kn surface currents, and to operate for a year without maintenance.

High-frequency radio communications will be maintained with Coast Guard shore communications stations in San Francisco and Miami for transmission to Weather Service facilities.

Leading to the procurement of the prototype buoy has been the testing of six large experimental buoys in the Gulf of Mexico, the North Atlantic, the northeast Pacific, and the Gulf of Alaska. Smaller buoys, both stationary and drifting, have also been tested off U. S. shores, including the Arctic, and have supplied some of the technology incorporated into the prototype design. Plans are to purchase five more of the buoys for deployment in 1976 off the West Coast and the Gulf of Alaska, an area where much of the weather affecting the United States is formed.

GREAT LAKES SPRING STORM SEASON

The Great Lakes have entered a period when spring storms can cause serious erosion and flooding, and have in past years. The present high-water situation on most of the Lakes only serves to increase the possibility of significant property damage.

The frequency of severe storms on the Great Lakes begins increasing in the fall, reaches a maximum in midwinter, then gradually declines through late spring. A severe storm can be described as one where the winds are strong, continue over an extended time period, and come from a fairly constant direction. The months just before freezeup (generally, October, November, and part of December) and just after ice breakup (usually from mid-March through May) are considered the most critical. Added to the spring potential are rising lake levels caused by snowmelt and runoff. Such storms, besides building beach-punishing waves, can actually tilt a lake's surface. For example, it is not uncommon to record a simultaneous difference of over 12 ft at either end of Lake Erie (See "Great Lakes Navigation Season, 1974," page 150.). When already high lake levels are forced even higher by storm winds, the result is erosion and flooding of low-lying areas. The Army Corps of Engineers estimates that of the 10,000 mi of Great Lakes shoreline, 1,300 mi are

subject to above-normal erosion, 200 mi to critical erosion, and 300 mi to flooding.

"Monthly Bulletin of Lake Levels," a U.S. Department of Commerce publication, contains a 6-mo forecast of lake levels which is prepared by the U.S. Army Corps of Engineers. The latest Bulletin indicates that in 1975, except for Lake Ontario, all lakes are expected to be above their long-term averages and only slightly lower than they have been the last few years. The forecasts are based on the trend of past water supplies and incorporate anticipated precipitation. They have proven to be quite accurate, especially considering that the water levels are forecast 6 mo in advance. Major deviations in rain and snowfall, such as occurred in December and January, can alter those forecasts. Except for Lake Superior, all the Lakes are lower than they were 1 yr ago, but, in most cases, still well above their long-term averages. Lake Ontario, very near its long-term average, appears to be in the best shape.

Lake Survey operates and maintains over 50 water-level gaging stations around the Great Lakes. Critical areas such as the west end of Lake Erie, Lake St. Clair, Saginaw Bay, and Green Bay, as well as others, are monitored closely by the National Weather Service, especially during the spring and fall storm seasons. Several forecast offices are connected directly to key water-level gage stations and receive similar data from selected U. S. Coast Guard Stations where water-level gages have been installed. With this information, plus knowledge of expected weather conditions, "Lakeshore Warnings" are issued from 12 to 24 hr in advance of a potentially damaging storm. Such warnings are normally carried on AM and FM radio stations, television, and continuous weather broadcasts on VHF-FM 162.55 mHz, or 162.40 mHz.

While the lake level situation is improving, the levels are still high enough to cause damage if a bad storm should occur. It is recommended that shoreline property owners check their dikes, seawalls, or other protective devices, and make any necessary repairs as soon as possible. National Weather Service experts note that 1974 was relatively mild for severe storms compared to 1972 and 1973, and no one can be sure what is in store for 1975.

BARNACLE-FREE SHIP BUILT

The barnacle, the little shellfish that clings to a ship's hull and costs the world's shipping industry hundreds of millions of dollars every year, may eventually be relegated to the status of marine curiosity. After 3-1/2 yr in barnacle-infested Nicaraguan waters, the COPPER MARINER, the first shrimp trawler built with a copper-nickel hull, has proved the barnacle can be completely frustrated, according to the developers.

So successful has the COPPER MARINER been that four new shrimp trawlers with copper-nickel hulls have been built at Santa Cruz, on Mexico's west coast. They have sailed for Sri Lanka, to start operations with a big Indian Ocean fleet. The fleet's owner expects each of the new 52-ft copper-nickel trawlers to gross $130,000 a year more than a conventional steel or wood trawler, plus a $3,000-a-year savings in hull maintenance. The savings will come from keeping the trawlers operating continuously--not having to haul them out to scrape and paint the bottom--and from reduced fuel consumption because of the clean hull.

By now, the story of the COPPER MARINER is well known in the shipping world. The big question is whether the savings on such a hull made by the profitable shrimping industry can be made on other kinds of ships. The developers believe that copper-nickel-clad steel hulls for large commercial and naval vessels, and big yachts, will become a reality in the next few years. They also are starting research on the possibility of bonding a copper-nickel metallic cladding to large fiberglass hulls.

If all that comes about, not only the barnacle, but most saline corrosion of metal hulls, would be conquered. The copper-nickel alloy plates used on the shrimp trawlers are solid, according to the company which supplied them. Copper-nickel cladding already is made for use in some kinds of water and chemical tanks.

Copper has been known as the enemy of the barnacle for 2 centuries. Wood sailing ships were clad with thin copper sheathing for many years to foil the barnacle and the teredo marine wood-boring worm. But this never was totally effective, and the sheathing lasted only about 10 yr. It was ultimately destroyed by electrolytic reaction on the copper of saltwater and the iron nails that held the ship together. Modern bottom paints containing copper salts, used on all kinds of ships and boats, are even less effective, but since modern ships move much faster than early sailing vessels, they are not quite so vulnerable to the barnacle.

The copper-nickel alloy not only foils the barnacles, it is much more resistant to saltwater corrosion than painted steel. However, the cost of bottom painting is the smallest saving envisioned. The big gains will be in slashing fuel consumption drastically by always having a clean hull, and keeping ships operating practically year-round without being hauled out for maintenance.

NOAA AIRCRAFT TRAILS WINTER STORMS OVER ATLANTIC; SCIENTISTS TEST SATELLITE OCEAN SENSORS

As winter storms spin into the Atlantic north of Cape Hatteras, conditions behind these cold fronts--clear weather and high, seaward-blowing winds--create an ideal laboratory for testing new laser and microwave devices designed to measure ocean waves from space. The occasional existence of this natural laboratory in the wake of winter storms has drawn a team of scientists from NOAA and NASA, aboard one of NOAA's heavily instrumented research aircraft, into the air over the Atlantic.

Staging out of NASA's Langley Research Center, NOAA's C-130 aircraft and the scientific team are trailing the parade of winter storms out to sea, flying patterns at levels from 300 to 20,000 ft to test how clearly new remote-sensing devices "see" wave motion at the sea surface. The project will provide data needed to develop and refine proposed airborne and satellite sensors, including those scheduled to fly aboard SEASAT, the first satellite dedicated to observing the ocean from space, planned for launch late in the decade.

Project leader Duncan Ross, an oceanographer with the Atlantic Oceanographic and Meteorological Laboratories (part of NOAA's Environmental Research Laboratories) in Miami, Fla., explains that even un-

Figure 31.--With cargo door open and the "RADSCAT" antenna deployed, operator adjusts a down-pointing laser used to profile ocean wave heights beneath the airplane.

der conditions of constant wind, the return energies received from the ocean surface can be altered by other factors. For example, what is interpreted as ocean-wave slope and height is highly dependent on how long a time local wind conditions have persisted, and over what distance the wind is blowing. These returns are even affected by how stable the atmosphere is at a given time and location. Thus, to predict how the surface will "look" to the sensors, it is necessary to know what variations to expect from various combinations of windspeed and duration, and the distance over the water, or fetch.

The conditions behind a winter cold front off the Atlantic coast give a near-perfect environment for this kind of experiment. There are constant winds in the 25- to 35-kn range, blowing offshore. This results in the ability to monitor varying returns as fetch increases in the seaward direction.

The experiment flight plan covers a primary area of operations extending from Cape Fear, N. C., to New York City, a region where offshore winds characteristically follow the passage of low-pressure systems.

The instruments being tested are installed aboard the C-130 aircraft. They include two types of radar, a laser profilometer, and a microwave radiometer, all looking seaward at the same time. One of the radars, called a "RADSCAT," uses a 4-ft dish antenna; to deploy this system, the airplane's aft cargo door must be opened in flight, and the dish aimed at the ocean surface (fig. 31).

The airplane begins with a low-level downwind pattern, flown at 300 ft above the ocean. This pattern is designed to specify the surface windspeed, wave height, and whitecap and foam coverage. The latter quantities increase greatly with distance from shore (fetch), and play a dominant role in the nature of microwave returns from the sea surface. On this sequence, the aircraft obtains data from shore to a point about 200 mi offshore, measuring the wind by means of an inertial navigation system, and profiling the waves with a laser Geodolite.

After completing the low-level flight track, the aircraft climbs to 10,000 ft, the cargo door is opened, and the RADSCAT antenna is deployed. Naturally emitted and backscattered microwave data are taken

with the antenna "looking" at different preselected angles off vertical as the airplane heads toward shore. The airplane flies alternately seaward and shoreward, taking a series of RADSCAT tracks.

A final pattern is flown at 20,000 ft to take data with an L-band imaging radar system, a device that yields wave patterns and spectra, and which images other features on the ocean surface.

NOAA INVESTIGATES "SUPERNOVA" STORMS FOR KEY TO TROPICAL WEATHER PICTURE

Nocturnal storms that grow so explosively they are called "supernovas," after the bright, giant stage of a collapsing star, appear to be key figures in the tropical weather picture being assembled by NOAA. The storms were discovered during GATE, the international Global Atmospheric Research Program Atlantic Tropical Experiment, which investigated the ocean area and atmosphere west of Dakar, Senegal, last summer.

The storms may play an important role in exchanges of energy between the sun-heated ocean and the atmosphere--exchanges that profoundly influence weather around the world. The familiar night rain maximum of the Tropics, generally held to be caused by a reversal of the sea breeze, is probably related to supernova thunderstorms. And the disturbances may provide a missing link between alternating waves of high and low pressure in the tropical belt of prevailing easterly winds and the development of some waves into hurricanes.

The search for what turned out to be the fast-growing thunderstorms came from the efforts of GATE scientists to reconcile the atmosphere they encountered west of the African continent with what meteorological "conventional wisdom" had led them to expect. Some previous investigations suggested that there would be very strong updrafts along the Intertropical Convergence Zone. This was expected to be one of the strongest phenomena in the area. But the clouds found during GATE barely reached up to 40,000 ft, and the air was so dry the aircraft frequently left no vapor trail at that altitude.

The Intertropical Convergence Zone is a meteorological equatorial zone where the atmospheric systems of the Northern and Southern Hemispheres meet. Until GATE, scientists believed the convection, or vertical motion, associated with this meeting was much stronger than it turned out to be. The question then was: Where is the missing violence in this system?

At least a partial answer came from close study of the hourly infrared images beamed earthward by SMS-1, in geostationary orbit some 22,300 mi above the equatorial Atlantic. On the infrared images (fig. 32), the small, bright-white dots of developing thunderstorm anvils were found, which formed during the night, not during the day. These systems grew rapidly, expanding from areas of hundreds of square miles to areas of thousands of square miles in an hour or two; but by each day's forenoon, the violent storms had already begun to decay into actionless layered cloud systems.

The supernova storms are the kind of system seen in large Colorado hailstorms. They must come out of a strong atmospheric instability somewhere, and it is thought that nocturnal radiation processes play a role in their formation. It cannot as yet be explained why and how they form over the ocean, at night.

Cloud physics measurements taken aboard several aircraft in the GATE squadron -- the Soviet Ilyushin 18C, NASA's Convair 990, and a DC-6 from NOAA's

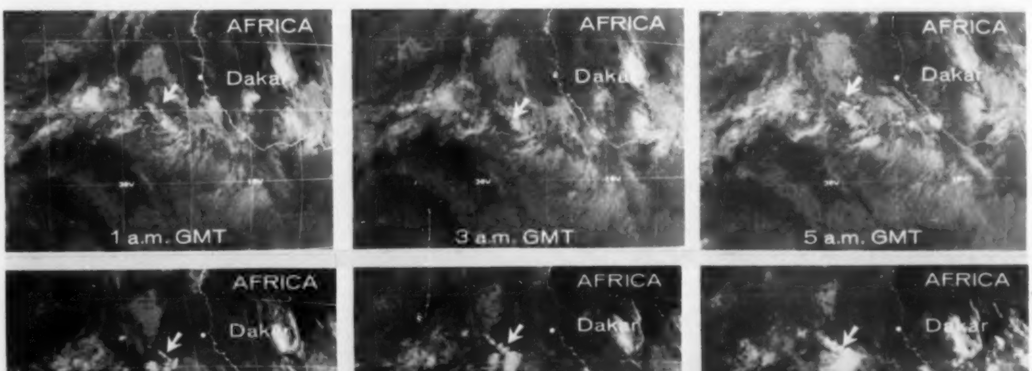


Figure 32.--This series of infrared images from SMS-1, in geostationary orbit over the Equator, shows the supernova storm developing through the early hours of the morning on August 10, 1974. The storm system (arrow) appears as a series of white dots, which become the high, anvil tops of mature thunderstorms by 5 a.m.; by noon, the storms show considerable expansion as high-level winds spread their cirrus anvils. By midafternoon, they have begun to dissipate, becoming layered clouds beneath a cirrus shield covering thousands of square miles.

Research Flight Facility -- indicated that the large storms are linked to peculiarities in the tropical Atlantic's hydrologic cycle (the movement of water and its cargo of latent heat energy into, through, and out of the atmosphere). They found very large counts of ice nuclei, the small particles on which atmospheric water freezes, but very low counts of cloud condensation nuclei, on which water vapor condenses to form clouds. This suggests that the clouds become rained out before the water even reaches the atmosphere's freezing level. What little water content is lifted beyond this level is effectively seeded, or even overseeded, to produce large cirrus anvils. The high ice-nuclei counts off Africa also suggest that deliberate attempts to improve rainfall with cloud-seeding techniques, which add artificial ice nuclei to the natural "population," would not be successful.

The large ice-crystal cirrus cloud caps blown off the anvil tops of the supernovas had no haloes, indicating they were formed when droplets froze, but retained their spherical shape, possibly creating a kind of hybrid between water drops and ice crystals called a "droxtal." On the other hand, cirrus cloud layers above the anvils did show haloes, indicating well-formed ice crystals at that level. This could mean that the storms are sometimes linked, possibly by an upper-level updraft, to high-altitude waves in the easterly winds. Such a connection could explain what sustained the supernovas observed in August that finally developed into a tropical storm.

NORTHWIND REACTIVATED

U.S. Coast Guard Cutter NORTHWIND (fig. 33), a veteran of 30 yr of polar icebreaking service, will be returned to active status in July. Her reactivation follows an extensive 2-yr overhaul at the Coast Guard Yard, Curtis Bay, Md. The overhaul is designed to extend her useful service life by 5 yr. Improvements to the 269-ft-long vessel include machinery modernization and installation of a new pollution abatement system.

Figure 33.--The NORTHWIND battling through heavy ice northeast of Point Barrow, Alaska. The icebreaker has had an extensive overhaul and will soon be ready for action again. U.S. Coast Guard Photo.

Commissioned in 1945, NORTHWIND operated out of Seattle, Wash., for most of her career, and has several polar service records to her credit. In 1969, she became the first ship ever to transit the Northwest Passage eastward and westward in a single season, and accompanied the SS MANHATTAN on the historic Arctic Tanker Northwest Passage Project in September 1969.

Following a shakedown training cruise with her new crew in July, NORTHWIND will stand ready to add more pages to her colorful history from her new East Coast home port at Baltimore, Md.

LETTERS TO THE EDITOR

This nice letter was received from Mr. Mitchell S. Rebich, radio officer on the SEA-LAND EXCHANGE.

"To you of NOAA: I have just read your copy of the Mariners Weather Log, Vol. 19, No. 1, January 1975. As a radio officer, I don't see many of these copies; apparently they all go to the mates. A copy addressed to Radio Officer, c/o this vessel, would be appreciated.

"As an old hand at weather sending, I have been sending four weather reports per day either to Coast Guard stations or KOK, Los Angeles. It would be very nice if your office would commend KOK, Los Angeles, as that station has done a very good job. I have a continuous schedule with him for the 1200 weather report, and, for the past year, he has not failed me. On nearing 180°, most reports are sent via NOX, Adak, and between NOX and KOK, four reports a day are sent.

"I know how important weather is. I remember how I struggled to send weather reports from Hampton Roads, Va., to Dahlgren, Va., at five words a minute in 1927, so I have been sending weather a long time.

"My best regards to all Port Meteorological Officers, especially my good friend Mr. Walter Sitarz, who I believe is now stationed in Miami, Fla.

THE MARINERS WEATHER LOG WELCOMES ARTICLES AND LETTERS FROM MARINERS RELATING TO METEOROLOGY AND OCEANOGRAPHY, INCLUDING THEIR EFFECTS ON SHIP OPERATIONS.

MARINE WEATHER REVIEW

Smooth Log, North Atlantic Weather

November and December 1974

The SMOOTH LOG (complete with cyclone tracks [figs. 36-39], climatological data from U.S. Ocean Station and Buoys [tables 11 and 12], and gale and wave tables 13 and 14), is a definitive report on average monthly weather systems, the primary storms which affected marine areas, and late-reported ship casualties for 2 mo. The ROUGH LOG is a preliminary account of the weather for 2 more recent months, prepared as soon as the necessary meteorological analyses and other data become available. For both the SMOOTH and ROUGH LOGS, storms are discussed during the month in which they first developed. Unless stated otherwise, all winds are sustained winds and not wind gusts.

SMOOTH LOG, NOVEMBER 1974--The storm track pattern was near normal, but the concentrations differed. The number of storms was below normal, but more intense. The primary track across Hudson Bay continued eastward past Kap Farvel rather than into Baffin Bay. The primary tracks along the St. Lawrence River and just off the East Coast were secondary tracks, and the secondary track farther off the coast was a primary track and was continuous to over the northern United Kingdom. Only one major cyclone roamed the Mediterranean Sea.

The 998-mb Icelandic Low was almost identically located with its 1001.8-mb climatological counterpart near 61°N, 30°W. A secondary 1000-mb Low existed, near 62°N, 08°W, resulting in lower pressures over northern Europe and the Scandinavian countries. The Azores High was displaced to the east at 1023 mb. The major center was at 38°N, 18°W, with two 1022-mb subcenters over the Mediterranean Sea. This resulted in higher than normal pressures throughout that area. Pressures over the southeastern United States were above the climatic mean. There were also two distinct areas of low-pressure troughing; one over the Great Lakes and another from Newfoundland southwestward off the U.S. east coast.

The major anomalies corresponded to the pressure centers. A negative 8-mb center was located near the Orkney Islands, with a 5-mb subcenter near 60°N, 30°W. Another negative 4-mb center was near 40°N, 55°W, in connection with the major trough. The positive anomalies were over the Mediterranean Sea--5 mb, a 4-mb center off Lisbon, and a large positive area with a 6-mb center that stretched from northern Quebec over Baffin Island to northern Greenland.

The hemispheric upper-air pattern was basically a large ring with a geometric center near the North Pole. The major Low center affecting the North Atlantic was near 80°N, 100°W. A major trough extended down Baffin Bay, across Labrador, and off the U.S. east coast. Another major trough extended eastward from southern Greenland and then southeastward across the North Sea. A minor trough was over the Midwestern States. The zonal flow was well developed across the North Atlantic between 35° and 60°N.

There were no tropical cyclones this month.

Extratropical Cyclones--The first storm of the month came across Hudson Bay and on the 1st was over northern Quebec. The VGBZ, west of Cape Breton Island, recorded 40-kt gales. The LOW center moved slowly across the Labrador Sea and, at 0000 on the 3d, had a central pressure of 964 mb. Kap Farvel measured 50-kt northeasterly winds.

To the south, an upper-air cutoff LOW was dissipating and the surface LOW started moving northeastward. As this low-pressure area joined the major circulation of the northern LOW, the POST CHAMPION and UNION SUNRISE found 40-kt gales east of the center. On the 4th, the southern LOW combined with the frontal system and gale-force winds were blowing between 40° and 55°N east of the front. Kap Farvel now had 60-kt storm winds. The LOS ANGELES, at 41.3°N, 34.6°W, had 48-kt winds, 13-ft seas, and 26-ft swells from the south.

By 1200 on the 4th, the southern LOW could no longer be found in the analysis, but very strong winds were blowing just ahead of the front. Near 46.5°N, 30°W, the POLAR COLUMBIA was fighting 55-kt portside winds with 30-ft seas and 39-ft swells. Farther north, the Y.S. VENTURE, near 54°N, 27°W, reported 50-kt winds, and the H1070 just a few miles south was bucking 45-kt gales and 16-ft seas.

The LOW was moving into the Denmark Strait on the 5th, and the BUNTENSTEIN, near 58.5°N, 34°W, had 40-kt gales and 20-ft seas and swells. The LOW grounded on the Greenland coast on the 6th, and sank on the 7th.

A stationary LOW south of the Denmark Strait started moving eastward, on the 9th, as a perturbation from the coast of Labrador moved into its circulation. By 1200 on the 10th, the disturbance had developed into a small 986-mb LOW, near 54°N, 22°W, south of the main center. The CHERTAL was caught almost in the center with 45-kt gales and 23-ft seas. The small LOW sped northeastward and, by 1200 on the 11th, was the major center of circulation over the Shetland Islands. The CHERTAL, which was moving westward, was now fighting 55-kt winds, near 53.5°N, 25°W, and the seas were a keel-cracking 49 ft. The LOW moved northward off the Norwegian coast, on the

12th, still a large but mild storm. It was filling rapidly, though, and by the 14th was no more.

This frontal wave formed over the Grand Banks, on the 11th, and moved rapidly eastward. At 1200 on the 12th, it was a 990-mb LOW near 50°N, 27°W. The BRANSFIELD was about 5° latitude to the south with 45-kt gales. During the next 12 hr, the circulation really intensified, although the reported winds did not exceed 40 kt. Ocean Station Vessel "K" was on the edge of the storm, at 0000 on the 13th, with 40-kt gales, but the seas were 26 ft, which is what this storm was noted for. By 1200, there were many 35- to 45-kt wind reports around the southern part of the storm. The H. R. MACMILLAN, near 51.5°N, 20°W, reported 39-ft swells. The BRANSFIELD and KILO were still reporting 26-ft seas and swells toward the outer edges of the circulation. The STAGHOUND, at 46.1°N, 27.7°W, at 1800, reported 29-ft seas.

At 0000 on the 14th, the 956-mb LOW was approaching the northwest coast of Ireland. A ship off Lands End reported 50-kt winds. High seas were being reported in many areas of the large storm. The RED JACKET, near the Azores, measured 28-ft seas and 30-ft swells crashing into her starboard side. The MACMILLAN was battered with 34-ft swells near 48°N, 24°W. Ocean Station Vessel "I" suffered 23-ft swells on the 15th.

As the LOW moved into the Norwegian Sea, it was filling but still maintaining a large circulation. The MAGNUS POSER, far south of the center near 43°N, 25°W, felt the 50-kt effect. On the 15th, a new LOW developed off Cabo Finisterre and moved into the English Channel. This weakened the LOW considerably and it finally disappeared off the Norwegian coast on the 18th.

Early on the 18th, there was an area of weak gradient between a HIGH over the U.S. Southeast and the main HIGH off the Canary Islands. By 1200, ship reports indicated no doubt of a well-developed 988-mb LOW near 37°N, 57°W. The ELIZABETHPORT passed very near the center and, at 1800, was mauled by 64-kt northerly winds, with 16-ft seas. The pressure gradient on the west side of the LOW was much greater than in the other quadrants. The OSSENDRECHT, sailing southwestward, passed just east of the center, and at 0000 on the 19th was at 37.9°N, 51.9°W with 60-kt storm winds from the northwest. Her pressure had risen 7 mb in 3 hr. The seas were only running at 12 ft, but the swells were 26 ft.

The gale-force winds continued in the southwest and west quadrants and now were more widespread. Far to the southwest of the center, near 33.5°N, 50°W, the DOCEBARRA was headed into 50-kt northwesterlies. At 1200 on the 19th, the VAN TRIUMPH reported only 15-kt winds near the storm's center, but, at 0000 on the 20th, about 300 mi southwest of the center, they were 50 kt. The storm continued its east-northeastward track producing only gale reports. Ocean Station Vessel "K" measured only 35-kt gales as it passed to the north, but the seas were 26 ft. To the southwest, the BOOKER VANGUARD was near 43°N, 20°W, and again only 35-kt west winds were reported, but the swell was 31 ft from the southwest.

The LOW passed over southern England, on the 22d, and decayed rapidly over the North Sea.

This storm's major claim to fame was while it was very young and over the Great Lakes area. It was the result of the combination of two weak low-pressure areas. One formed over the central plains on the lee side of the Rocky Mountains, and the other over the Canadian Provinces of Alberta and Saskatchewan, on the 18th. A high-pressure area was moving off the U.S. east coast and feeding moist air northward ahead of the incipient systems. On the 19th, the two depressions combined, forming a consolidated circulation.

At 1200 on the 20th, the 995-mb LOW was centered over northern Lake Michigan with its cyclone circulation affecting the eastern third of the continent south of the James Bay. By nightfall, gales were over the lake area as far south as the Ohio River Valley. On the 21st, storm warnings were in effect for Lake Erie, with gale warnings for the remainder of the Lakes. Warnings for beach erosion and flooding were posted for the eastern shore of Lake Erie, with 12-ft waves reported. The CASON J. CALLOWAY on Lake Erie and the J. L. MAUTHE on Lake Huron both measured 42-kt winds. By 1200, westerly winds of 50 kt and 14-ft seas had been reported. Gales also caused beach erosion and flooding on the eastern shore of Lake Michigan. At that time, the center was off Portland, Maine, and the pressure had dropped to 974 mb. Gale-force winds were now occurring off the Atlantic Seaboard.

At 0000 on the 22d, Ocean Station Vessel "H" measured 40-kt winds and 18-ft seas, which increased to 45 kt and 21 ft, by 1200, with hail. Thunderstorms were being reported by many ships along the trough line behind the front. The BAYANO, at 36.3°N, 66.4°W, was headed eastward with 42-kt winds and 30-ft seas.

This storm was the "exception that proves the rule." When it moved offshore, it started to fill and weaken, rather than deepen and intensify as so frequently happens. Gale-force winds were still blowing in the western half, near the coast. Part of the reason for the weakening was a stubborn HIGH, which was slowly retreating eastward and was blocking the LOW's movement. It continued to move slowly east-southeastward at about 15 kt.

At 1200 on the 24th, the 997-mb LOW was near 39°N, 50°W. The FRUBEL AMERICA, near 37°N, 54.5°W, was pounded by 50-kt winds, 16-ft seas, and 20-ft swells. The EXPORT LEADER and the KRALJEVICA, northwest and southwest of the center respectively, both reported 45-kt gales, as did the ANCHORAGE, at 37.3°N, 55.4°W, at 1800, but with 30-ft swells. The LOW continued southeastward and squeezed between two HIGHs with gale-force winds. Finally the wear and tear was too great, and the storm was spent by the 28th.

A slow-moving front that paralleled the U. S. east coast moved off the coast and over water about 1800 on the 25th. At 0000 on the chart of the 26th, a wave was analyzed near Cape Cod. The GYPSUM EMPRESS was just off the New Jersey coast with 35-kt north-northwesterly winds. By 1200, the storm system was a well-developed 990-mb LOW. There were four reports of 40-kt winds in the southwestern quadrant behind the front. The LAURITA, at 39.4°N, 69.5°W, also reported 30-ft seas. The Greek freighter ELARKADIA (5,109 tons) was blown aground at Grande Vallee, Quebec, when the wooden bollards on

the wharf broke off. The vessel was holed and pounded heavily on rocks. The cargo was discharged, and the vessel refloated and towed to drydock. The 984-mb LOW tracked northeastward across the Gulf of St. Lawrence on the 27th. At 0000, the GYPSUM EMPRESS was near Cape Cod with 45-kt winds. At 1200, the VITAUTAS PUTNA, near 42.5°N, 62.5°W, was hit by 55-kt storm winds from the west. As it moved over the cold land and water of the Labrador Sea, it appeared to lose some of its punch, although the central pressure did not change appreciably.

The eastern third of the United States and the North Atlantic south of 40°N was a large area of flat gradient. There were HIGHs and LOWs, but none were intense. At 0000 on the 29th, a LOW formed near 39°N, 58°W at 1009 mb. The LOW intensified rapidly to 980 mb, at 0000 on the 30th, near 54°N, 48°W. The SEA-LAND MCLEAN fought 55-kt winds at 45.4°N, 44.8°W, at 0600. The drilling ship VC 8062 was near 47°N, 48.5°W, and reported 70-kt hurricane-force winds, with seas and swells of 25 ft. To the southwest of the center, the STOLT LLANDAFF suffered 40-kt northwesterlies. On the 1st, the AMORIA, near 45°N, 41°W, was battered by 60-kt winds and 33-ft swells about 150 mi south of the center.

The storm was racing northeastward and, at 1200 on December 1, was still 980 mb, near 54°N, 27°W. Gales were blowing from south of the storm to across Scotland and Norway. The AMERICAN ACE, near 48.5°N, 30°W, had 45-kt gales on her bow. By 0000 on the 2d, the 973-mb LOW was about midway between Iceland and Scotland. The TILLIE LYKES dragged both anchors in strong winds at Firth of Forth, Scotland, at 0130, while loading and discharging barges. Nine barges broke loose, and one went aground and holed. The other eight were salved.

The LOW moved into the Norwegian Sea where it brought gales to the coast of Norway. It continued northward toward Spitsbergen, where it dissipated.

Casualties--The Portuguese AMBOIM (5,895 tons) ran aground in fog off Lisbon, on the 20th. Further damage was sustained because of weather, and the vessel was sold for scrap.

SMOOTH LOG, DECEMBER 1974--There was an above-average number of cyclones this month across the North Atlantic. The overall pattern was as usual, from the North American east coast south of Labrador toward the Norwegian Sea. The primary tracks out of the central and eastern United States were farther south than normal. As these tracks moved off the coast, they had a more easterly than northeasterly component, as is usual. This took the storm paths farther eastward than the climatological tracks indicate, and, therefore, more storms passed east of Iceland than the climatic mean would indicate. Two centers traversed the northern Mediterranean Sea. The United Kingdom and central Europe were relatively free of storm centers, but not their effects. The storm track across Hudson Bay was easterly rather than northeasterly into Baffin Bay.

The pressure pattern reflected the more easterly track of the storm centers. The Icelandic Low was centered over the Norwegian Sea at 987 mb, near 68°N, 02°E. The climatological center is 1000.7 mb near 62°N, 38°W. A subcenter at about 993 mb was located near that position.

A sharp trough stretched from the Norwegian Sea Low to south of Iceland, to St. Johns, Newfoundland, and then paralleled the east coast of the United States about 500 mi to sea.

The Azores High (1031 mb) was centered over Spain rather than its normal location of 35°N, 33°W, at 1021.1 mb.

The anomalies were large and centered near the pressure centers. A negative 18-mb was centered off Norway near 66°N, 03°E. A positive 14-mb center was near Bilbao, Spain, and another positive 13-mb center was located over Hudson Strait.

The misplaced surface centers were reflected in the upper-air pattern. At 700 mb, the primary low center was located near its normal position over Ellesmere Island, but about 100 ft lower than normal. Another center was over the Norwegian Sea, reflecting the surface center there. A closed High was positioned off Portugal, resulting in a 400-ft anomaly over the surface high. The Norwegian Low and the Spanish High resulted in a very tight pressure gradient across northern Europe.

Extratropical Cyclones -- This system formed off the Gulf Coast in an inverted trough associated with a weak front. A large double-celled east-west oriented HIGH was located north of the Great Lakes. The HIGH remained quasi-stationary, while the LOW moved toward the north. The tight gradient produced easterly winds gusting to 40 kn and waves of 8 to 10 ft. The 210-ft Canadian cargo ship JENNIFER, about 20 mi northeast of Milwaukee, sank, on the 1st, when her cargo shifted. All aboard were rescued. See a more detailed account on page 95 of Vol. 19. No. 2. There was much flooding and beach erosion on southern Lake Michigan and the southwestern shore of Lake Erie. At the same time, gale-force winds were blowing off the Carolinas and in the Gulf of Campeche. EB-13 reported 31-ft seas with 40-kn southeasterly winds. On the west side of the front, which was off the Georgia coast with a small frontal wave, the REIYO MARU had only 30-kn winds from the west with 16-ft seas, but the swell was 26 ft from the southeast. The COSMOS FOMALHAUT was north of the Yucatan Peninsula, near 22.5°N, 88.5°W, and sailing into 55-kn northwesterlies with waves to 25 ft. Gusts reached 52 kn at Washington National Airport, and were reported as high as 60 kn in New York. On the 1st or 2d, the 3,714-ton Panamanian MARTHA S. radioed she was taking water in mountainous seas about 350 mi northeast of Miami, and her pumps could not handle it. She later reported her pumps were repaired and proceeded to Philadelphia. The BOSTON, at 33.9°N, 74.9°W, was battered by 48-kn winds, 16-ft seas, and 25-ft swells.

As the LOW's center moved up the East Coast, it deposited heavy snows in the Appalachian Mountains. In western Maryland, roads were blocked and power outages occurred as 30 in fell. On the coast, Delaware and Maryland beaches and resorts took a beating, and damage ran into the millions of dollars. The 27,977-ton Liberian ore carrier OSWEGO LIBERTY collided with the 30,724-ton Liberian bulk carrier

Figure 34.--The first major storm of the winter pounds a seawall along the New England coast. Winds were reported to have gusted to hurricane force. Wide World Photo.

STRUMA, in Annapolis anchorage, and was beached. High waves from the "Northeaster" battered the New England shore (fig. 34). On the 2d, OWS HOTEL reported 50-kn winds. At 1200, the EXPORT AIDE needed some as she was deluged by 75-kn hurricane-force winds and 39-ft waves. At 0000 on the 3d, the chart showed that several centers had developed off the northeast coast. The EXPORT AIDE was now south of one of these temporary centers, near 36°N, 66.8°W, and fighting 65-kn winds and 31-ft swells. Twelve and 24 hr later, she was still fighting 60-kn winds and waves up to 36 ft, as she sailed northwestward toward the coast and haven.

The 974-mb LOW moved over the Gulf of St. Lawrence on the 4th. At 1200, the ANTON DOHRN was hit by 50-kn winds and 26-ft seas off Cartwright. Late on the 4th, the system split into two centers, one continuing northeastward and the other turning southeastward. The ANTON DOHRN now had 60-kn winds and 39-ft seas, near the same location, with -2°C air temperature.

Late on the 5th, the main LOW was south of Kap Farvel and, by the 6th, had consolidated with a stationary LOW south of the Denmark Strait. The other center curved eastward, on the 5th, then northeastward on the 6th to die out on the 7th.

On the 12th, two large HIGHs dominated the North Atlantic south of Newfoundland and south of Iceland. On the 13th, a small LOW developed off Portsmouth as a cold front moved off the U. S. east coast. The LOW moved northeastward with little development until the 14th, when it was over the Labrador Sea. By midday of the 15th, it was 990 mb as it passed south of a LOW stalled between Greenland and Iceland. On the 16th, it absorbed that circulation, and the winds picked up. A station on eastern Iceland reported 45-kn winds, as did the HVASSAFELL, just off the coast. At 1200, the SONETTE was near 58.5°N, 29°W, struggling with 55-kn westerly winds and 16-ft seas. The next day, the SMIT LLOYD 14 found 45-kn gales over the North Sea.

On the 18th, the LOW crashed against the coast of Norway. An island or coastal station of the Netherlands reported 45-kn northwesterly gales. Later that day, the LOW jumped the mountains to near Helsinki and the Gulf of Finland.

The pressure over the southeastern U.S., on the 13th, was rather flat, with two high-pressure centers and one low-pressure center, within 3 mb pressure of each other. Early on the 14th, the systems developed and consolidated, as the LOW moved over Cape Hatteras.

By 1200, it was a well-developed cyclone near 37°N, 68°W. On the 15th, gale-force winds were blowing, with waves up to 20 ft. The THORSRIVER, near 37.5°N, 58°W, was hammered by 35-kn winds and 30-ft seas. Four ships reported winds in the 45-kn range. Among them was the AMERICAN LEADER at 42.4°N, 55.3°W, with 10-ft seas and 30-ft swells, which continued into the 17th. At 0600, the CORSICANA, at 38.2°N, 52.4°W, measured 55-kn winds. To the north of the 984-mb center (47.5°N, 46.5°W), the MANCHESTER CRUSADE (51.7°N, 47.5°W) had 45-kn winds quartering off her port bow, with 30-ft seas and swells.

The CHERTAL, at 51°N, 49°W, had chilling 50-kn northerly winds, on the 18th. This was the last significant wind report plotted as the storm raced between Iceland and the Faeroe Islands on the 19th, and into the Norwegian Sea on the 21st.

The forerunner of this storm started over northern Florida on the 16th. It was a beachcomber as it moved up the coastline to the Gulf of St. Lawrence by the 19th. On the 18th, several waves formed on the front, off the coast, but did not persist. Late on the 18th, three ships in the southern perimeter of the circulation were more concerned with the effect than the source. The AMERICAN EAGLE (32.6°N, 66.8°W) found 48-kn winds, 8-ft seas, and 30-ft swells. The CORSICANA (38.5°N, 58.5°W) measured 55-kn winds, 10-ft seas, and 36-ft swells, and the EXPORT BAY (37°N, 63.7°W) the same winds and seas, but only 20-ft swells. On the 19th, a new closed circulation developed, near 45°N, 50°W, at the occlusion. The CORSICANA slowly headed westward into 65-kn winds with no waves reported at 0600, but at 1200 recorded 33-ft swells.

It rapidly became the predominant LOW as it moved northeastward. VC 8062 reported 50-kn gales. At 1200, the ASIA FREIGHTER was near 42°N, 57°W with 50-kn winds. Gales were blowing all around the storm. At 0000 on the 20th, the DART ATLANTIC, at 47°N, 42°W, also found the 50-kn isotach. The wind and seas of 21 ft were from the west, and the 30-ft swells from 250°. Twelve hours later, she was still battling 50-kn winds, 23-ft seas, and 30-ft swells. About 100 mi south, the DART AMERICA was fighting 55-kn winds, but the highest waves were only 25 ft, and she was moving with them. Still farther south, near 42°N, 43°W, the NEW ENGLAND SCOUT reported 50-kn winds and 26-ft seas.

Through the 21st, the LOW moved almost due east. The AMERICAN ARGOSY reported 48-kn winds, 25-ft seas, and 33-ft swells, at 1200. On the 22d, the LOW turned northeastward. The wind reports were not as strong, but weather ship JULIETT was hit by 45-kn gales as the center passed about 60 mi to the north. This was its last breath, as it expired by the next day.

The pressure gradient was flat over the eastern United States and off the East Coast, on the 21st. On the 22d, it started to organize, and a LOW formed off Cape May. As it moved northeastward and over the Gulf Stream, it deepened, dropping 15 mb in 24 hr.

By 1200 on the 23d, the 985-mb center was at 42.5°N, 54.5°W. At that time, the ATLANTIC COGNAC, near 40°N, 60°W, was sailing into 50-kn winds and 33-ft seas. The CHEVRON LIEGE, NEDER EBRO, and SUSSY all reported 45-kn gales. At 1200 on the 24th, the FRANKFURT was being swept by 60-kn winds and 30-ft swells at 41.2°N, 41.3°W. The MUENCHEN, about 80 mi to the north, suffered 50-kn winds and smaller seas.

On Christmas Day, the AVON FOREST was near 47°N, 25°W with 45-kn gales. Although there were no extreme winds, most ships between 35°W and the coast, and 40° to 55°N, had gale-force winds. On the 26th, the LOW started to weaken and curve northwestward toward Greenland, where it dissipated.

The weather forecaster and analyst working shift on Christmas Eve found this storm. It was over southern Indiana at 0000 on the 25th. Its upper-air support was in a strong wind band of the zonal flow. The LOW raced eastward and, by 0000 on the 26th, was near 40°N, 62°W, and 986 mb. Twelve hours later, the central pressure had dropped to 964 mb. Three ships reported 50-kn winds in the southern half of the circulation. They were the CHEVRON LIEGE, DJIBA, and MIECZYSLAW KALINOWSK. Forty- and 45-kn winds were common as far as 500 mi south of the center, and to the East Coast.

At 0000 on the 27th, the 960-mb center was at 48°N, 42°W. Off Notre Dame Bay the APATIT battled 55-kn winds. VC 8062 measured 50-kn winds, and the pressure had risen 16.8 mb during the past 3 hr. East of the occlusion, near 46°N, 33°W, the NOVODRUZHESK also had 50-kn winds and 23-ft seas.

During the next 24 hr, the storm moved northeastward with little change in pressure, but the maximum winds reported were 45 kn. Ocean Weather Station "J" was one of these and was also tossed by 30-ft seas and 15-ft swells. The seas were from the west-southwest, and the swells from the south. On the 28th, the storm joined another LOW near Iceland.

This LOW formed over the Gulf of St. Lawrence, on the 30th, in conjunction with a frontal system out of another LOW over Ungava Bay. It moved over the Strait of Belle Isle, and SEDCO I had 45-kn gales at 0000 on the 31st. Twelve hours later, it was 982 mb near 57°N, 46°W, with gale winds on both sides of the front. The LOW center passed over Kap Farvel as it raced toward the Denmark Strait on January 1. At 0000 on the 2d, the ERNST KRENKEL, about 120 mi south of Kap Farvel, struggled with 55-kn winds at -4°C. She reported 5 cm of ice from spray building slowly. The pressure of the LOW had dropped to 949 mb. Later that day, 40- to 45-kn winds were no oddity from south of Iceland to Scotland, and to northern Norway. Höfn, Iceland, measured 50 kn, as did Ocean Weather Station "M," along with 28-ft seas. On the 3d, it was absorbed by a semipermanent LOW over the Norwegian Sea.

There were no ship reports on the Mediterranean to indicate high winds, but one ship sank and one ran aground during this storm over the Sea. On the 29th, the Sea was bracketed by two HIGHs, one off Cabo Finisterre with a ridge extending across Spain into Algeria, and another over southeastern Turkey. On the 30th, a 1010-mb LOW formed north of Messina. Cagliari, Sardinia, measured 40-kn winds at 1200, and the Cypriot CHRISSO (1,910 tons) ran aground at Porto Caverna. The crew was rescued. At 0000 on the 31st, Naples measured 50-kn winds, and Malta 35

kn, as the 996-mb center moved into the Ionian Sea. At 1200, there were three weather station reports of 35-kn winds around the center--Tunisia, Libya, and Yugoslavia. The U.S.S.R. 5,923-ton KOMSOMOLETS KALMYKII capsized and sank off Cape Carbonara. Six crewmembers died, and three were missing. The LOW weakened as it moved southeastward into the eastern Sea on the 3d. No further gale-force winds were reported.

The final transit through the St. Lambert Lock of the Great Lakes-St. Lawrence Seaway for the season was made by the Greek freighter GEORGIOS A., on the 17th. This same ship was in a collision with the Laker H. LEE WHITE in the St. Clair River on the 11th.

Casualties--The British motorvessel BENGATE arrived Bermuda, on the 7th, with cargo shifted by heavy weather. The 21,530-ton American OVERSEAS ALEUTIAN broke mooring lines while discharging at Donges, France, on the 9th. The vessel drifted aground and was refloated with the aid of tugs. The 500-ton British drilling supply vessel TROPIC SHORE was smashed against a leg of the drilling platform BRITANNIA by a freak wave, in the North Sea, on the 5th. The vessel was holed and sank.

The Panamanian HALCYON SUN (706 tons) ran aground near El Bluff, Nicaragua, on the 13th, while in ballast, when a heavy squall caused her to drag her anchor. These two vessels must have been the victims of thunderstorms, as the Mediterranean was under the influence of high pressure. On the 18th, the 500-ton Panamanian KASTEL LUANDA was driven aground in heavy weather while moving to shelter at Ponza Island in the Tyrrhenian Sea. The 21,185-ton Greek JOHN COLOCOTRONIS was driven aground off Tripoli, during heavy weather on the 21st. The Liberian YAGA (524 tons) sank in heavy seas off Cabo Finisterre, on the 23d, when the cargo shifted.

Smooth Log, North Pacific Weather

November and December 1974

SMOOTH LOG, NOVEMBER 1974--The storm tracks this month were diffuse. There was one path where there was a relative concentration. It was across the Gulf of Terpeniya to the Near Islands and then along the Aleutians into the Gulf of Alaska. The storms that formed south and east of Japan had no favorite path. The primary climatological tracks are from over and east of Japan to the Near Islands, from there toward Bristol Bay, along the Aleutians into the Gulf of Alaska, and south of the Aleutians into the Gulf of Alaska.

The mean pressure pattern closely matched climatology. The Aleutian Low was a flatter oval this month with two centers rather than the 1000.4-mb one. One 996-mb Low was centered near 57°N, 150°W, and the other at 997 mb was near 56°N, 175°E. There were also two High centers versus the normal one at 1021 mb. They were 1023 mb near 33°N, 166°W, and 1022 mb near 33°N, 130°W. The usual large High over central Asia was normal in location and pressure of 1034 mb.

The anomalies were not large. There was a negative 7-mb center over the Sea of Okhotsk and a negative 8-mb center over the Gulf of Alaska. The major positive anomaly was 5 mb centered near 40°N, 170°W.

As with the Atlantic, the upper-air flow was mainly zonal in the mean. There were major troughs located near both coasts, one over the Sea of Japan and the other approximating an arc from Kodiak Island to 45°N, 145°W, to 30°N, 150°W. The major anomaly centers were a negative one over the Sea of Okhotsk and a large positive one over the central ocean--30° to 40°N, 150°E to 150°W.

Extratropical Cyclones--This LOW materialized over Manchuria, on the 2d, and moved over the Sea of Japan on the 3d. On the 5th, it developed a double LOW system that was to persist for several days, which is unusual. The HONDURAS MARU found 40-kt gales near 39°N, 162°E. Later, Ostrov Urup measured 50-kt gales. The HONSHU MARU, at 48.8°N, 169.3°E, measured 47-kt gales with 15-ft seas.

The 6th was a big day, with gale-force or higher winds all around the center. The YOZAN MARU and ASAHI MARU both reported 50-kt winds and the STAR BILLABONG was ravaged by 25-ft seas and 44-ft swells near 46.5°N, 168.5°E, which increased to 33-ft seas and 49-ft swells 6 hr later.

By 0000 on the 7th, the LOW had reached 970 mb, near 53°N, 180°, with ships still fighting gale-force winds. The SAKHALINSKIE GORY in the Bering Sea, at 57.5°N, 174°W, had 45-kt gales. On the 8th, the SYUKO MARU (46.4°N, 173°W) measured 38-kt winds, 16-ft seas, and 33-ft swells, and the VAN CONQUEROR (47.9°N, 163.3°W) measured 50-kt winds with no waves reported. The storm center crossed into the Gulf of Alaska, on the 9th, and a ship was hammered by 33-ft waves at 48.5°N, 165°W. At 0000 on the 10th, the SUMMIT was in Shelikof Strait and was battered by 60-kt near-hurricane-force moving air. After that last effort, the storm died fast as another LOW passed to the south, and a large HIGH approached from the southwest.

Monster of the Month--On the 11th, there was a broad area of low pressure, with multiple centers, that covered the western two-thirds of the Bering Sea and extreme eastern Siberia. A large 1040-mb HIGH was centered near 45°N, 160°W, and feeding warm moist air into the eastern Bering Sea. By 0000 on the 12th, the pressure had dropped rapidly and consolidated into one large deep LOW (956 mb) off Mys Navarin. Winds up to 40 kt were blowing across island and

coastal stations. At 1200 on the 12th, the LOW was 948 mb over the Bering Strait. Nome recorded prevailing winds of 35 kt from the south. A ship north of Saint Paul Island had 45-kt winds and 15-ft seas. Winds as high as 60 kt were reported to have battered the western Alaskan coast. Waves breeched the seawall and flooded some areas of Nome to a depth of 5 ft (fig. 35). Numerous people were forced from their homes, many of which were damaged. Approximately half the town was without electric power, the sewage system was out, and the water supply suspect. On the 13th, the LOW moved into the Chukchi Sea, and LOWs moving around the southern periphery weakened the gradient over the Bering Sea.

This was a series of short-lived storms that formed on the southern outskirts of the large deep LOW described above. This first storm formed, on the 11th, off Tokyo and raced northeastward. On the 12th, it started to deepen and a ship northeast of the center reported 40-kt winds with a thunderstorm. The H3DQ was slapped by 50-kt winds as the storm roared past. On the 13th, it crashed onto the shore of Bristol Bay.

This vicious cyclone had its inception after 1200 on the 13th. No ships reported anything of consequence until 0000 on the 15th, when it was 968 mb in the Gulf of Alaska. Nearly all ships within 500 mi experienced at least gale-force winds. The SEA FAN was ravaged by 60-kt winds near 54°N, 142°W. The PORTLAND, about 120 mi to the north, combated 55 kt. To the southwest near 53°N, 148°W, the TOWA MARU was sailing into 50-kt winds and 33-ft swells, and the KENJYU MARU, just a few miles away, braved 45-kt winds. As the LOW roared ashore near Montague Island, the HILLYER BROWN was swept by 60-kt winds and 25-ft waves.

The very deep LOW had moved into the Chukchi Sea and another weaker one developed and replaced it in the northern Bering Sea. In a trough lying near 180° another LOW came to life and raced eastward. Within 12 hr it was 990 mb and generating 50-kt winds

Figure 35.--It was cleanup time on Front Street in Nome. At one point, water 5 ft deep covered the business district. Wide World Photo.

as reported by the MARUSUMI MARU (46°N, 168°W) and the KASUGAI MARU (47°N, 176°W). The VALENTIN KOTELNIKOV was closer to the Bering Sea LOW, near 54°N, 180°, where she was lashed by 60-kt winds. The NIKOLAY OSTROVSKIY report south of Unimak Island was plotted as 70 kt, but the direction was about 90° from what it should have been, so the speed value may be wrong also. About 120 mi northwest of the LOW, the FYODOR KRAYNOV reported 55-kt winds. In the southern part of the LOW the waves rose over 20 ft. On the 17th, the BURMAH LAPIS encountered 55-kt winds 500 mi west of the center. They were accompanied by 12-ft seas and 33-ft swells. Later that day, the pressure dropped to 972 mb, but 12 hr later was rising as the cyclone pushed against the mountainous coast of British Columbia.

A wave formed south of Kyushu on a stationary front late on the 16th. A LOW also developed over the Sea of Japan. They paralleled the coast of Japan and joined forces on the 18th. The first strong winds were in the warm sector late on the 18th. The EASTERN BUILDER was near the warm front (40.5°N, 167°E), at 0000 on the 19th, with 50-kt winds. Attempting to be impartial, the FUGO MARU was near the cold front (43°N, 162°E) with 45-kt winds. What she lacked in wind speed she made up in wave height, with 26-ft swells. The PLUTOS, at 40.4°N, 153.1°E, was pounded by 60-kt winds and 16-ft waves. The NANCY LYKES, far to the south at 34.1°N, 147.9°E (about 900 mi), still was stung by 47-kt gales, with 16-ft seas and 33-ft swells.

The storm's circulation was now nearly a perfect circle with a central pressure of 960 mb. Gale-force winds were reported in all directions. At 0000 on the 20th, the lowest pressure of 957 mb was reached when the ASIA LOYALTY, near 49.5°N, 164.5°E, struggled with 60-kt winds, 20-ft seas, and 23-ft swells. Another ship to the northeast fought 50-kt winds. It turned out to be the JUJO MARU and 12 hr later was still fighting the battle.

On the 21st, another LOW developed east of the main center elongating the circulation, but it did not help the JUJO MARU as she was still on that 50-kt isotack with 16-ft seas and 40-ft swells. A ship north of the Aleutians was on the same isotack. The WASHINGTON MAIL, at 53.2°N, 179.2°W, braved 48-kt winds and 25-ft seas.

The new LOW was rapidly growing and within hours became the major storm. By the 22d, the original LOW was just a trough in the circulation of the new LOW.

This was another storm spawned over the Sea of Japan. It was a slow starter. It came to life on the 20th, but was of little concern until the 22d. By that time it was a large storm, but with a relatively weak gradient and light winds. On the 23d, the winds were blowing. The HOTAKA MARU, at 43°N, 155.1°E, found 50-kt winds with nearby ships reporting 40- and 45-kt gales. The center was moving rapidly across the Bering Sea until it came to a more rapid halt and stalled on the 24th and 25th. On the 24th, the ALASKAN MAIL was north of the Aleutians and headed northwestward with 50-kt winds on her stern. She was being rocked by 25-ft waves. Waves over 20 ft were not uncommon south of the Islands. Ostrov Beringa was measuring 50- and 55-kt winds. The 10,231-ton Liberian bulk carrier GERANIUM, carrying a cargo of logs and scrap iron, was last heard from on the 24th at 56.1°N, 178.5°E, about 300 mi northeast of Attu. Aircraft searching the area after she was reported overdue found a lifeboat belonging to the vessel, and logs were reported near her last known position. By the 25th, the LOW was deteriorating as the next described LOW took over the wand. The storm still had destructive force, as the SPERO experienced 28-ft swells near 50°N, 177°W.

This storm came out of the Yellow Sea on the 22d. On the 24th, it split into two centers straddling Honshu and the eastern center took over. By 1200 on the 25th, it was a 984-mb cyclone with 40-kt winds, and part of the overall circulation of the last storm. The central pressure continued to drop and, at 0000 on the 26th, was 956 mb near 45°N, 177°W. The KINYO MARU, due west of the storm center at 178.5°E, had 60-kt winds on her starboard side. The following ships reported 50-kt winds: JAPAN MAIL (42°N, 177°E), MARITIME VICTOR (52°N, 171°E), SEALAND COMMERCE (42°N, 174°E), and the SHUTOH MARU (37°N, 179°W). The JAPAN MAIL also reported 16-ft seas and 38-ft swells.

By 1200 that day, the other LOW had vanished. The chart for 0000 on the 27th had as many ship reports plotted in the North Pacific as I have seen. THANKS! The pressure of the LOW was now 950 mb and 45-kt winds common occurrences. High waves were the order of the day. The KIYOSHIO MARU, at 41.2°N, 159.9°W, had 50-kt winds, 33-ft seas, and 33-ft swells. Just to the north the LOTUS' winds were 5 kt lighter, but she fought the same seas. The PAPYRUS MARU was probably in greater trouble near the center (48°N, 164.5°W) with only 25-kt winds, but 16-ft seas from 320° and 33-ft swells from 130°.

The storm continued a northeastward track with gales, but she was now growing old. On the 29th, she was buried on the Kenai Peninsula of Alaska.

The front that was associated with the LOW above stretched westward to the northern edge of typhoon Irma. In midocean, near 28°N, 154°E, a wave formed. It raced east-northeastward, until 1200 on the 29th, when it was at 43°N, 162°W with a 973-mb center. On its way, there were several reports of gales. The HAWAII was at 43°N, 160°W with 50-kt winds, 25-ft seas, and 21-ft swells. Twelve hours later, the KEISHO MARU was about 90 mi south of the center and battling 60-kt winds, 15-ft seas, and 25-ft swells. To the southwest, the NEDLLOYD DEJIMA, near 41°N, 160°W, was cruising with 50-kt winds, 30-ft seas, and 39-ft swells on her stern.

Gale-force winds continued blowing until the storm stalled near 48°N, 150°W. The pressure was rising by December 1, and it no longer existed late on the 2d.

This was the marriage of two LOWs with very different backgrounds. One was from the subtropics, near 26°N, 156°E, circa 1200 on the 29th. The other was a northerner from near 47°N, 153°E, circa 1800 on the 29th. The northerner was born a bully, battering Ostrov Simushir with 60-kt winds 6 hr later. By 1200 on the 30th, 50-kt winds were still occurring and the LOW had a central pressure of 976 mb. The southern

LOW had matured to 980 mb and was headed northward. The LOTUS was near 41°N, 177°E with 45-kt gales and 25-ft swells, while the SHINYU MARU was near 47°N, 155°E with 40-kt gales, 20-ft seas, and 21-ft swells, at 1200 on December 1.

The two storms were introduced on the 1st, and married on the 2d, with the northerner joining the southerner to form a 966-mb LOW near 48°N, 175°E. The stronger wind band--35 to 40 kt--was about 800 to 1,000 mi southwest of the center. On the 2d and 3d, it executed a loop in the vicinity of 48°N, 175°E. At 1200 on the 2d, the PAPYRUS MARU was cautiously sailing into 55-kt winds, 25-ft seas, and 40-ft swells, near 43.5°N, 164.5°E. Not far away, near 41.5°N, 159°E, the EL SALVADOR MARU was braving 45-kt winds, 16-ft seas, and 33-ft swells. On the 3d, the WASHINGTON MAIL and another ship both encountered 50-kt winds, with waves up to 25 ft. The PAN ASIA measured 45-kt gales and 33-ft swells, at 54.6°N, 178°E, and the VAN CONQUEROR measured 58-kt storm winds at 43.6°N, 168.2°E. Twenty-four hours later, the HOTAKA MARU, at 42.6°N, 179.9°E, found the 50-kt wind band, and the WASHINGTON MAIL still had 45-kt winds, with the seas only slightly lower.

The front had moved far out ahead of the storm's center, and a new low-pressure center formed to the east on the 4th. This new center moved northeastward while the old center moved eastward, still generating gales. In the meantime, another new LOW was approaching from the west to become the system to contend with.

Tropical Cyclones, Western Pacific--The October typhoon attack on the northern Philippines continued into November. Two more typhoons banged across Luzon during the month, bringing the 2-mo total to six. The two big typhoons were Gloria and Irma. Both brought 100-kt plus winds and torrential rains to an already battered and helpless Luzon. Two tropical storms also formed in November.

Gloria was born on the 3d southeast of Yap Island. Moving and developing rapidly, she became a typhoon, by the 4th, near 13°N, 135°E. She turned from a northwesterly to a west-northwesterly track and headed for Luzon. Winds near her center blew at 85 kt early on the 5th. Near her center the FREDERICK LYKES encountered 50-kt winds from the northwest at 0000. The following day winds were up to 110 kt with gusts to 135 kt. She crossed the northeast coast of Luzon late on the 6th and maintained typhoon intensity on her journey across the rugged Island. By the 7th, the now-weakening storm was churning northwestward through the South China Sea; she dropped to tropical storm strength before the day was through. The following day, as a depression, Gloria slowed and turned southwestward before reaching mainland China, about 120 mi east of Hong Kong.

On the 21st, Irma was spotted about 100 mi north of where Gloria came to life. By the 24th, Irma was a big typhoon heading west-northwestward for Luzon. The following day the MIKUNISAN MARU and the ORENDA BRIDGE encountered 40- to 45-kt winds some 200 to 250 mi from Irma's center. She continued to intensify. By the 26th, maximum winds were estimated at 100 kt near her center, which was crossing the 130th meridian near 16°N. The next day winds reached a peak of 115 kt with gusts to 140 kt. Gales extended out 250 to 350 mi. The 3,002-ton Panamanian GREEN HILL sank at 26°N, 125.4°E, after the cargo shifted in stormy seas. Twenty crew members were rescued; three died, with one missing. Irma swung west-southwestward. She banged ashore northeast of Manila and turned westward as she crossed the Island. She lost most of her punch during the overland journey on the 28th. Irma dropped to tropical storm strength as she made it into the South China Sea. She continued to weaken, and, on the 30th, turned northward. Tropical storm Irma crossed the coast of mainland China on December 2, about 60 mi west of Hong Kong.

Faye was first detected in the central Philippines as a tropical depression on the 1st. She reached tropical storm strength the following day west of Manila. On the 3d, heading westward, Faye reached peak intensity when winds near her center blew at 50 kt with gusts to 65 kt. The following day she moved into South Vietnam near Bong Son. Tropical storm Hester flared up briefly in the South China Sea on the 15th. She reached tropical storm strength a few hundred miles off the coast of South Vietnam early in the day. Later Hester ran aground, just north of Nha Trang.

Casualties--The American-registered GREEN VALLEY reported heavy weather damage to 42 LASH barges. The Singapore-registered AN FU (3,543 tons) dragged anchor at Sado Island, Japan, where she had taken refuge during heavy weather, and ran aground. The vessel was later refloated and escorted to drydock.

SMOOTH LOG, DECEMBER 1974 --The major difference in the storm tracks this month from climatology was a major path from southern Japan eastward to midocean and then northeastward into the Gulf of Alaska. According to climatology storms forming south of Japan would move northeastward toward the Near Islands. Other tracks are across La Perouse Strait toward the western Bering Sea, from the Near Islands toward the Pribilof Islands, and from the central Aleutians and the midocean into the Gulf of Alaska. There are also secondary tracks from the Gulf of Alaska and midocean toward Vancouver Island, then inland. These tracks were generally followed except in the instance above.

The monthly mean sea-level pressure pattern was near normal in configuration. The significant difference from the climatological mean was a shift of about 20° longitude toward the east, and more intense pressure centers. The 1001.3-mb Aleutian Low (53°N, 162°E) was located near 52°N, 178°W, at 992 mb, with a 993-mb subcenter near 57°N, 148°W. The Pacific High, normally 1021.9 mb at 32°N, 145°W, was 1027 mb at 33°N, 135°W. The 1021.5-mb High center normally over the Northwestern Great Basin was 1025 mb near Salt Lake.

There were five areas of large anomalies that were directly associated with the weather of the North Pacific. Two were negative and colocated with the low-pressure centers, a 16-mb in the Gulf of Alaska and

11 mb with the Aleutian Low near 50°N, 176°W. Three were positive, a 6-mb center near 34°N, 133°W, and a 4-mb center near Salt Lake. The third was a large area of multiple centers averaging plus 14 mb over east-central Asia and Siberia.

The upper-air pattern at 700 mb was near straight west to east flow across the broad ocean expanse. There were slight troughing tendencies near both coasts and in the central ocean. The height gradient was more intense than normal as were the height centers. The height of the pressure surface averaged about 180 ft higher than normal across the central ocean and about 350 ft lower at a center south of Adak Island.

There were two tropical storms this month, Judy and Kit, for a total of 33 named tropical cyclones for the year. This compares with an average of 25.6 for the period 1945-73. In only four other years has this number been equalled or exceeded: 1964-40, 1965-34, 1967-35, and 1971-35.

Extratropical Cyclones -- This LOW was noted for coastal winds rather than those reported by ships. If the winds were measured on the coast they probably also occurred at sea, but were not reported or observed. It formed as a frontal wave, on the 2d, and rapidly moved toward the coast. The ESSO NEWARK reported 35-kn gales near Cape Mendocino early on the 3d. Later in the day, the ESSO NEWARK, HAWAIIAN LEGISLATOR, and UTAH STANDARD reported gales. By 0000 on the 4th, the winds had gusted to 48 kn at Pillar Point, Calif., and the HAWAII had 40-kn gales off the Washington coast. Twelve hours later, as the cold front moved onto the coast, gusts to 60 kn occurred. The cold front deposited 5 to 8 in of rain in the mountains of southern California. The LOW disappeared against the Coast Mountains.

A frontal wave departed the port of Shanghai on the 1st. It was very minor until the 3d, when it was south of Tokyo. The storm raced eastward, and it was not until the 6th that the winds developed, but on the 5th there were reports of 25-ft swells south of the center. At 0000 on the 6th, the 973-mb LOW was near 42°N, 168°W. Winds over 50 kn were now being measured, by the ASHBY MARU (35.8°N, 171.6°W) and the PACIFIC ARROW (37.8°N, 154.5°W). The CHALMETTE, at 33.3°N, 174.6°W, found 68-kn winds and 20-ft seas. At 1200, the YANG MING was pounded by 33-ft seas.

At 0000 on the 7th, the EASTERN BUILDER measured a 60-kn storm at 38.9°N, 156.9°W. The storm moved past Ocean Station Vessel "P" later that day. The winds reached 40 kn, and the seas 23 ft. The storm moved into Alaska on the 8th.

The weather pattern across the North Pacific had been diffuse for several days, both at the surface and aloft. On the 1200 surface chart of the 7th, there were three LOWs along approximately 50°N. A trough had formed south of the western two LOWs, and a small center developed in the trough. It developed rapidly, moving between the two LOWs as the westernmost one, over the Kurils, remained stationary, and the other moved eastward along the Aleutians.

At 0000 on the 8th, the 982-mb LOW was at 43°N, 169°E. The KENJYU MARU was northeast of the center with 40-kn gales. At 1200, the KASUGAI MARU at 41.6°N, 159.8°E was pounded by 45-kn gales. By 0000 on the 9th, the circulation had consolidated into two centers, the other being over the Gulf of Alaska. The SHINKO MARU was tossed by 40-kn gales about 300 mi southwest of the center, while the HANETIA was battling 55-kn storm winds 900 mi away in the southwest quadrant. On the 10th, gale-force winds were reported as far as 1,200 mi south of the center. By 1200 that day, the storm was near 52.5°N, 172°W, at 967 mb. Its circulation dominated the ocean from shore to shore as far south as 30°N. The HAWAIIAN QUEEN was near the Washington coast, at 47.2°N, 126.6°W, with 56-kn winds from the south-southeast, and 15-ft seas. At 0000 on the 11th, a ship hit 60-kn winds at 48°N, 141°W. As the storm entered Bristol Bay, it lost its forward motion and was filling rapidly. By late on the 13th, it had disappeared.

This storm must have set some kind of record in its race across the Pacific. It also helped contribute to the demise of the last storm. It formed near Tokyo on the 10th. By 0000 on the 12th, it was only 995 mb, but was already in midocean near 37°N, 177°E. It passed south of the OCTAVIA, treating her to 50-kn winds, north of the RHINE MARU with 45 kn, and gave the AMERICAN LIBERTY the same gift a few hours before passing her. The LIBERTY was really tossed about as she had 16-ft seas from the southwest, 13-ft swells from 210°, and a 7-ft swell from 320°. On the 13th, the PHILADELPHIA and the WASHINGTON MAIL, both in the vicinity 52°N, 133°W, were hit by 50-kn winds. The LOW was now deepening significantly and, at 0000 on the 14th, was 970 mb. At that time, the PHILADELPHIA (54°N, 135°W) and the WASHINGTON MAIL (53°N, 141°W) both suffered 50-kn winds, with waves as high as 25 ft. The QUADRA (49°N, 137°W) and the USCGC RUSH, near Sitka, braced 45-kn winds.

This energy only lasted a few hours as the storm beat against the mountains.

An inverted wave deepened over Korea and a LOW formed over the Sea of Japan on the 13th. The LOW developed rapidly as it moved across Japan. At 1200 on the 14th, it was 985 mb with 40-kn gales both to the south and east of the center. At 0000 on the 15th, it was near 39°N, 154°E, and 976 mb. The surface LOW developed, as an upper-air wave moved out of Asia. By the 15th, an upper-air LOW had formed at 700 mb. The SHUKO MARU, which was in the warm sector of the occlusion near 37°N, 167°E, was battered by 55-kn southwesterlies. The sea and swell were both 16 ft. Off the coast of Hokkaido, at 41°N, 147°E, the JAPAN MAIL had 50-kn starboard winds with 33-ft swells.

By 0000 on the 16th, the cyclonic circulation around the 962-mb LOW was over 1,800 mi in diameter. The fastest wind reported was 55 kn by the EASTERN BUILDER, near 40.5°N, 159°E. Five other ships battled 50-kn winds. They were the ALASKA MARU (16-ft seas, 26-ft swells), OSTROGOZHSK (33-ft seas), PACIFIC BEAR (13-ft seas, 20-ft swells), and PHILIPPINE MAIL (12-ft seas, 23-ft swells), all in the southern quadrants. The other ship was north of the center with 13-ft seas and 26-ft swells.

The center of the LOW was moving eastward about 200 mi south of the Aleutians. At 0000 on the 17th,

the VAN FORT was about 450 mi south of the center sailing into 60-kn winds with swells of 44 ft. At 1200 on the 17th, the first indication of weakening and breaking up occurred, near 38°N, 170°E, with the formation of a small LOW. Twelve hours later, the small LOW could not be analyzed with the data available, but its influence or residual influence was felt by the MARITIME DOMINION when she was ravaged by 70-kn hurricane-force winds near 34°N, 174°E. The seas and swells were both 25 ft. On later charts, the maverick LOW was reflected as a sharp trough.

On the 18th, the main LOW combined with a semipermanent LOW in the Gulf of Alaska. The gradient had relaxed, and only minimal gales were reported. The LOW wandered westward and rapidly filled on the 19th.

A LOW formed near Shanghai late on the 16th, but only survived about 36 hr. At 0000 on the 18th, the chart indicated three weak LOWs straddling Japan. By 1200, only the LOW over the Kuroshio Current remained. It deepened rapidly, and a ship reported 55-kn winds near the center. At 1200 on the 19th, the 970-mb LOW was at 44°N, 160°E. A ship 200 mi north of the center had heavy snow with easterly winds. Ships east and southwest of the center reported 40- to 45-kn winds. The PAPYRUS MARU, about 360 mi east of the center, had 23-ft swells from the east. At 0000 on the 20th, the PORT LOUIS MARU and the KASUGAI MARU fought 50-kn gales, with the latter reporting 30-ft swells. The PAPYRUS had lighter winds, but the seas were still 20 ft and the swells 25 ft.

Forty- to 50-kn winds continued through the 21st as the LOW neared Amchitka Island and dominated the northern ocean. As usual when LOWs this large develop, satellite LOWs formed near the edge of the circulation and moved around the perimeter. This did not help the WAKAMIYASAN MARU, which was between the two centers with 50-kn westerly winds. The British bulk carrier PACIFIC LOGGER (10,324 tons) broke a propeller shaft near 50.7°N, 170.2°W. She was encountering high winds and 35-ft seas, and trying to get a tow from the Coast Guard vessel BALSAM, which was forced to cut the lines previously placed on board.

After crossing the Aleutian Islands the LOW slowed on its northeasterly track. One of the satellite LOWs developed rapidly, on the 23d, and moved into the Gulf of Alaska. The USCGC STORIS was at 52°N, 155°W, at 1200, and measured 60-kn winds. The seas were 10 ft and the swells 25 ft. The STORIS had to abandon towing the 6,918-ton CORINNA due to the bad weather, but was standing by the vessel.

This storm was now the major concern to shipping, although the parent cyclone covered a larger area. At 0000 on the 24th, the CHEVRON HAWAII and the MOBIL OIL were both near 55°N and were battered by 60-kn howling winds. The CHEVRON HAWAII was thrashed by 20-ft seas and 41-ft swells at 142°W, while the MOBIL OIL enjoyed 12-ft seas and 34-ft swells, near 148°W. This LOW crashed into the mountains near Yakutat and disappeared over the Yukon on the 24th, while the old LOW became lost in the Alaska Mountains on the 25th.

This storm formed when the center of a LOW that had tracked out of southern Siberia split into two centers over the Kuril Islands. At 0000 on the 26th, the NANSHO MARU was hammered by 55-kn winds near 47.5°N, 155°E. The twin LOWs moved eastward, and the KEISHO MARU was in a strong wind band with 50 kn. There were seven reports of winds of 40 kn or greater within 2° of latitude 40°N from the Japanese coast to 170°E. As the eastward movement continued, the wind band spread both north and south. At 1200 on the 27th, the ALTAJSKIE GORY was wintering at 58°N, 172°E, with 50-kn bone-chilling winds. Ostrov Beringa and Ostrov Paramushir both measured 55-kn winds.

On the 28th, this one LOW dominated the Pacific north of 35°N. The LOTUS was near 47°N, 165°E with 50-kn winds, but her greatest worry was 26-ft seas and 30-ft swells. Ostrov Simushir was frozen by 65-kn typhoon-force winds of -2°C.

The LOW was stretched along the Aleutian Islands with four centers on the 29th. The USCGC CONFIDENCE, at 54°N, 148°W, measured 50-kn winds and 36-ft swells. Gale-force winds were common. Early on the 30th, the WORLD SUPREME was hit by 50-kn winds at 45°N, 175°E.

A wave formed near 50°N, 161°W on a front that developed out of a trough line. This storm intensified rapidly. By 1200 on the 31st, it had become the primary storm, and the old LOW had dissipated. The 954-mb center was just south of Montague Island in the Gulf of Alaska. The IDAHO STANDARD was at 54.1°N, 148.7°W, and was being tossed by 65-kn winds from the west. Near the coast, at 54°N, 136°W, the MOBILE was mauled by 50-kn winds with confused seas and 20-ft swells from both 200° and 260°. On January 1, the LOW moved ashore and was lost crossing the coastal mountains.

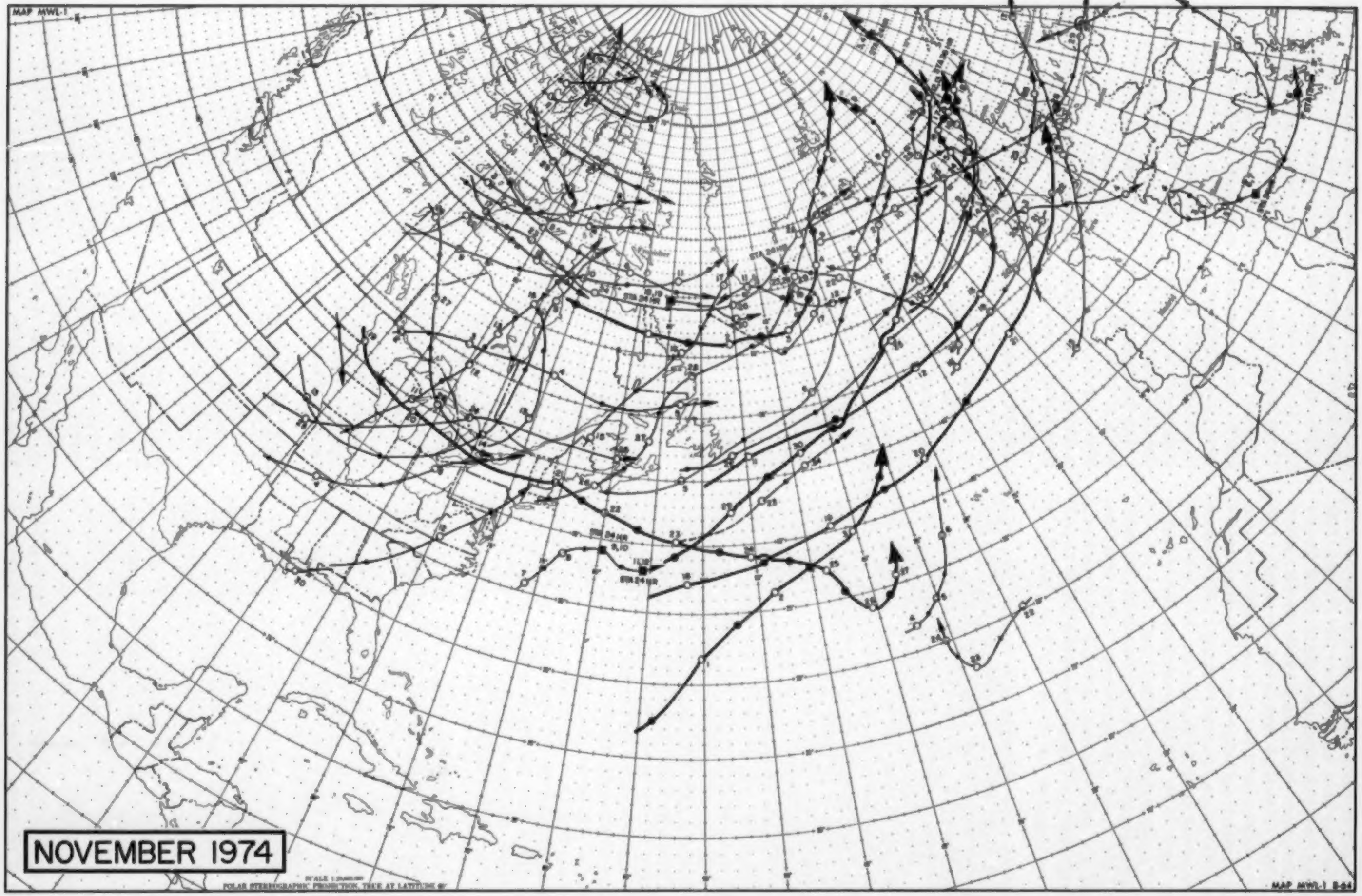
Frontogenesis was discovered over the East China Sea on the 28th. A low-pressure center materialized and moved eastward and, as it crossed the Kuroshio Current, intensified. Once under the direct influence of the zonal flow it raced across the central ocean and was of little consequence until it approached the Gulf of Alaska on the 2d. At 0000 of that day, the central pressure was 970 mb. The JAPAN BEAR and YAKU MOKAWA MARU were both in the vicinity of 44°N, 152°W with 55-kn winds. The former reported 33-ft waves. The NANSHO MARU was east of the center near 52°N, 142°W with 50-kn southerly winds. At 1200, Ocean Station Vessel "P" measured 50-kn northwesterly winds. As the LOW passed onshore near Sitka on the 3d, the GALVESTON, at 54°N, 137°W, felt the wrath of the 50-kn isotach. Gale-force winds were reported throughout the Gulf of Alaska.

Tropical Cyclones, Western Pacific -- Two tropical cyclones made December a little more active than usual. Both were tropical storms, and one moved across the Philippines, which have suffered their worst tropical cyclone season on record.

Judy flared briefly in the South China Sea. Her 2-day life was spent off the South Vietnam coast. From 15°N, 112.5°E, she moved southward as a tropical depression early on the 18th. Later, as a tropical storm, Judy moved toward the coast. Winds near her center reached 35 to 40 kn for a few hours. However, she slowed and turned northward near Nha Trang. Early on the 19th, Judy lost her punch.

(Continued on page 184.)

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic



NOTE: The extratropical cyclone tracks for the North Atlantic, October 1974, are all offset 20° longitude to the west.

Figure 36.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

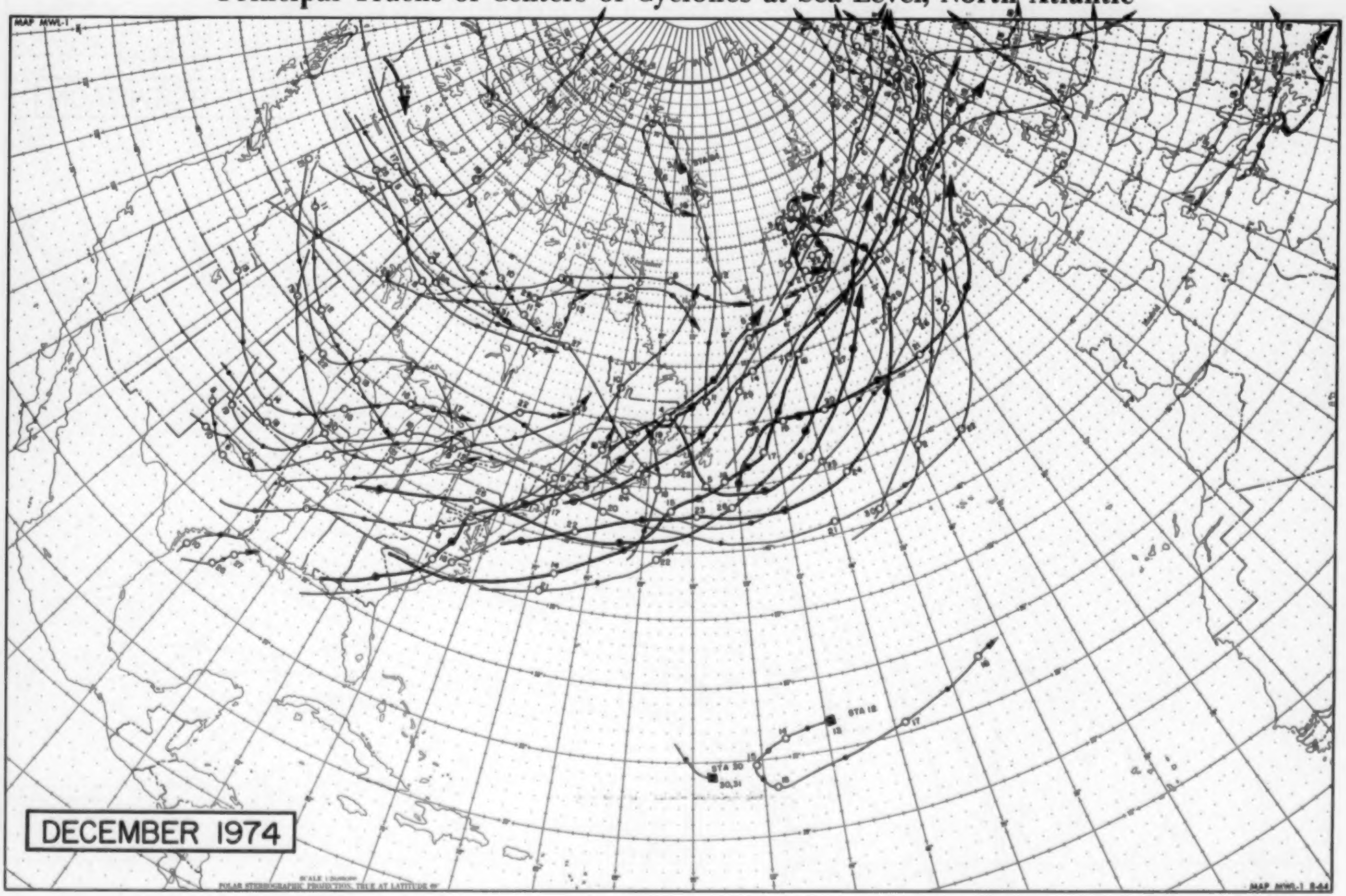


Figure 37.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

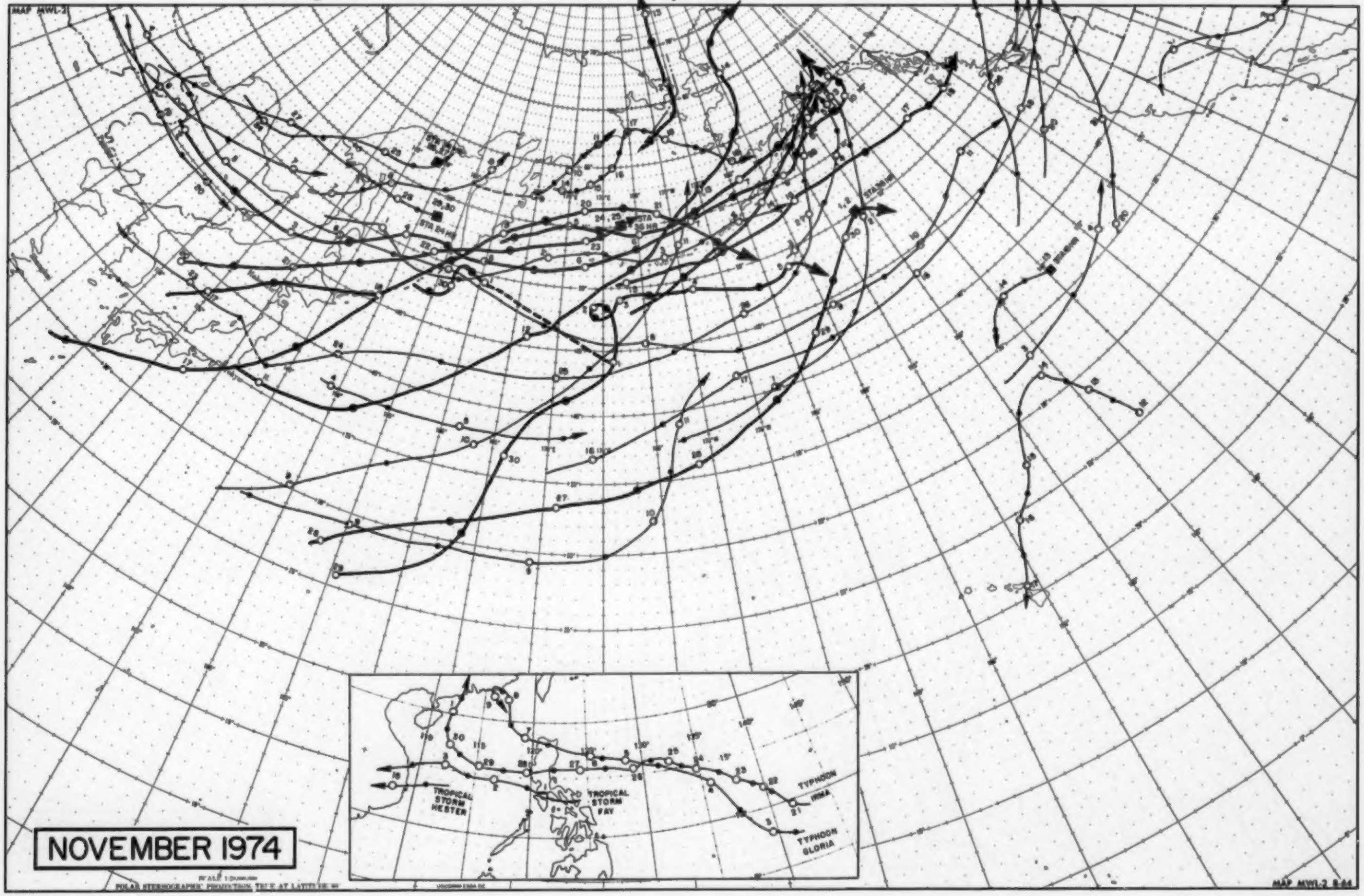


Figure 38.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

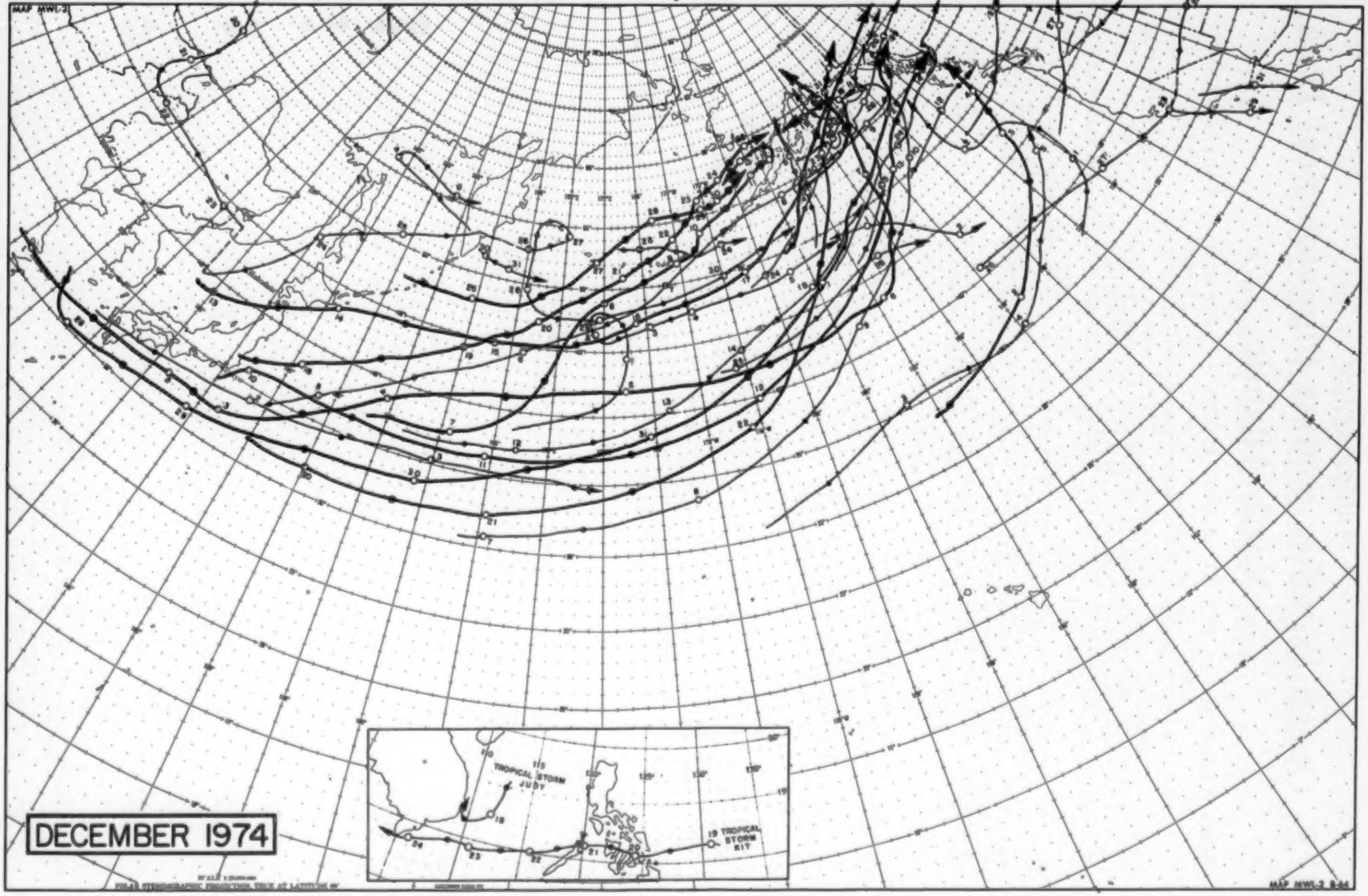


Figure 39.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Table 11
U.S. Ocean Weather Station Climatological Data, North Atlantic

Ocean Weather Station 'HOTEL' 38°00'N 71°00'W — November and December, 1974

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
NOV	5.5	26 18	15.1	22.3	13 06	- 1.3	30 06	10.3	19.5	*09 06	15.8	28 12	19.4	23.2	*24 03	-14.3	26 18	- 4.4	3.3	21 03
DEC	5.2	27 00	11.9	19.6	08 21	- 2.1	27 00	6.5	16.4	09 03	14.0	*27 12	15.9	20.1	17 15	-11.0	10 18	- 4.0	2.6	08 21

MONTH	PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC	PCPN	RAIN OR DRZL	SNOW	TSTM	VSBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
NOV	990.0	21 06	1015.9	1029.4	30 15	15.1	16.7	35.9	34.5	29.3	23.8	23.4	23.4	20	20	1	3	6	7	2	0	30	12.1	240
DEC	992.5	02 06	1016.3	1030.9	23 15	5.6	22.2	25.4	46.6	27.8	33.9	24.2	14.1	21	21	0	4	8	19	4	0	30	16.1	248

(Groups: MEANS AND EXTREMES — PRESSURE; PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS); DAYS WITH SPECIFIED WEATHER)

** VV-90-93 AND/OR W=4 COMP OB DAYS=COMPLETE OB DAYS

Wind

NOV WIND DIRECTIONS AND SPEEDS (% FREQUENCIES) — WIND SPEED (KNOTS)

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	1.7	7.7	4.7	.8	.4	15.3	20.2
NE	.0	2.8	4.4	1.6	.0	.0	8.8	14.5
E	.0	1.9	.3	.4	.0	.0	2.6	10.3
SE	.0	1.9	.8	.0	.0	.0	2.7	8.7
S	.0	1.0	1.0	.0	.4	.0	2.5	16.0
SW	.4	4.3	11.8	.8	.1	.0	17.4	15.0
W	.0	6.9	6.4	2.0	3.4	.3	19.2	18.5
NW	.0	5.0	11.1	5.5	4.4	.9	27.0	22.4
CALM	4.6	.0	.0	.0	.0	.0	4.6	.0
TOTAL	5.0	25.4	43.8	15.0	9.2	1.7	100.0	17.5

NUMBER OF OBS 240; MAX WIND: DIR 200, SPEED 55, DA HR *21 2200; VECTOR SPEED 10.7; MEAN DIR 305 (DIR IN DEGREES)

DEC WIND DIRECTIONS AND SPEEDS (% FREQUENCIES) — WIND SPEED (KNOTS)

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	3.1	5.0	3.9	.9	.0	13.9	19.0
NE	.0	3.8	5.3	2.1	.0	.0	11.3	16.2
E	.0	1.9	.6	1.7	.4	.3	4.9	21.0
SE	.0	.5	3.8	.6	1.2	.2	6.1	22.0
S	.0	1.4	2.3	1.3	.8	.3	6.1	20.7
SW	.0	1.2	2.0	1.4	.0	.0	4.6	18.1
W	.4	4.0	9.3	11.4	3.2	.0	28.3	21.5
NW	.0	1.7	5.3	10.0	7.2	.0	24.2	26.9
CALM	.4	.0	.0	.0	.0	.0	.4	.0
TOTAL	.8	17.7	34.7	32.3	13.7	.8	100.0	21.3

NUMBER OF OBS 248; MAX WIND: DIR 110, SPEED 57, DA HR 02 0500; VECTOR SPEED 9.9; MEAN DIR 302 (DIR IN DEGREES)

Wave

NOV WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES) — WAVE HEIGHT (METERS)

DIR	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	2.0	8.1	3.5	2.7	1.3	.0	.0	17.6
NE	.0	2.9	5.6	1.8	.0	.0	.0	.0	10.3
E	.0	.8	.0	.4	.0	.0	.0	.0	1.3
SE	.0	4.6	.0	.0	.0	.0	.0	.0	4.6
S	.0	1.4	2.1	.0	.4	.0	.0	.0	3.9
SW	.0	5.0	8.9	1.3	.3	.0	.0	.0	15.6
W	.0	2.5	2.3	.4	3.9	.7	.0	.0	9.8
NW	.0	5.4	9.7	3.4	5.8	2.2	.0	.0	26.6
IND	.0	8.3	1.7	.0	.0	.0	.0	.0	10.0
CALM	.4	.0	.0	.0	.0	.0	.0	.0	.4
TOTAL	.4	32.9	38.3	10.8	13.3	4.2	.0	.0	100.0

NUMBER OF OBS 240 — IND=INDETERMINATE

DEC WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES) — WAVE HEIGHT (METERS)

DIR	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	3.0	3.1	4.2	2.2	.0	.0	.0	13.2
NE	.0	4.9	1.9	1.2	.0	.0	.0	.0	8.1
E	.0	.6	1.0	.7	.3	.4	.0	.0	3.0
SE	.0	2.5	1.6	1.1	1.8	1.2	.0	.0	8.1
S	.0	3.2	3.6	3.7	4.7	.0	.0	.0	15.1
SW	.0	3.1	1.9	.1	.0	.0	.0	.0	5.1
W	.0	3.7	2.6	5.1	3.5	.0	.0	.0	15.0
NW	.0	2.4	3.3	3.5	10.4	.0	.0	.0	21.9
IND	.0	8.9	1.6	.0	.0	.0	.0	.0	10.5
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.0	33.1	20.6	21.8	23.0	1.6	.0	.0	100.0

NUMBER OF OBS 248 — IND=INDETERMINATE

NOV WAVE PERIODS AND HEIGHTS (% FREQUENCIES) — WAVE HEIGHT (METERS)

PERIOD IN SECONDS	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.4	11.7	4.6	.4	.0	.0	.0	.0	17.1
6-7	.0	6.7	12.1	3.3	3.8	.0	.0	.0	25.8
8-9	.0	6.3	15.8	5.4	7.5	.4	.0	.0	35.4
10-11	.0	.0	4.2	1.7	2.1	3.8	.0	.0	11.7
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	8.3	1.7	.0	.0	.0	.0	.0	10.0
TOTAL	.4	32.9	38.3	10.8	13.3	4.2	.0	.0	100.0

NUMBER OF OBS 240; MAX WAVE HEIGHT: HGT 6.5, PER 10, DIR 350, TYPE SEA, DA HR 08 21 — IND=INDETERMINATE (DIR IN DEGREES)

DEC WAVE PERIODS AND HEIGHTS (% FREQUENCIES) — WAVE HEIGHT (METERS)

PERIOD IN SECONDS	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.0	12.9	2.4	.0	.0	.0	.0	.0	15.3
6-7	.0	9.3	11.7	14.5	8.5	.0	.0	.0	44.0
8-9	.0	2.0	4.0	6.9	12.9	.4	.0	.0	26.2
10-11	.0	.0	.8	.4	1.6	.8	.0	.0	3.6
12-13	.0	.0	.0	.0	.0	.4	.0	.0	.4
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	8.9	1.6	.0	.0	.0	.0	.0	10.5
TOTAL	.0	33.1	20.6	21.8	23.0	1.6	.0	.0	100.0

NUMBER OF OBS 248; MAX WAVE HEIGHT: HGT 7.0, PER 10, DIR 140, TYPE SEA, DA HR 02 06 — IND=INDETERMINATE (DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

Table 12
U.S. Ocean Buoy Climatological Data
November and December 1974

DECEMBER — DATA SUMMARY — EB01
AVERAGE LATITUDE 35.1N — AVERAGE LONGITUDE 077.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	04.6	(10 12)	13.0	19.8	(25 00)	199	25
DEWPOINT TEMP (DEG C)	-01.7	(10 09)	08.9	16.8	(25 18)	199	25
SEA TEMP (DEG C)	12.6	(19 15)	20.0	23.8	(21 21)	198	25
AIR-SEA TEMP (DEG C)	-17.2	(10 12)	-07.0	03.0	(08 21)	198	25
PRESSURE (MBAR)	1002.7	(30 06)	1018.9	1032.3	(27 03)	199	25

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.0	3.0	8.0				12.1	12.0
NE		1.5	1.5				3.0	10.5
E		1.5	.5				2.0	8.3
SE		1.0	3.5	3.0			7.5	19.5
S	.5	1.0		2.0			3.5	17.9
SW	1.0	1.0	2.5	1.0			5.5	13.5
W		8.0	14.1	21.1			43.2	19.3
NW	.5	9.5	7.5	5.5			23.1	17.9
CALM								
TOTAL	3.0	22.6	37.7	36.7			100.0	17.2

NO. OF OBS: 199
MAX WIND — SPEED: 33 KNOTS; DIRECTION: 190 DEG; DAY: 16; HOUR: 15

PRECIPITATION
NO. OF DAYS WITH PRECIP: 14 NO. OF DAYS WITH REPORTS/ COMPLETE: 24 PARTIAL: 1
NO. OF OBS WITH PAST OR PRESENT PRECIP: 27 NO. OF WEATHER OBS: 199

NOVEMBER — DATA SUMMARY — EB12
AVERAGE LATITUDE 26.0N — AVERAGE LONGITUDE 094.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	15.8	(30 21)	24.0	27.9	(17 18)	240	30
DEWPOINT TEMP (DEG C)	08.3	(13 12)	18.4	24.2	(20 03)	240	30
PRESSURE (MBAR)	1011.1	(10 21)	1018.9	1031.3	(30 18)	239	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		2.5	7.1	7.1			16.7	18.8
NE		2.5	5.6	.8			8.8	14.9
E	.8	2.9	1.3				5.0	8.1
SE		5.8	11.7				17.5	12.8
S	.4	7.5	27.9	1.3			37.1	13.9
SW	.4	2.9	4.2				7.5	10.0
W	1.3	2.5	.8				4.6	8.0
NW	.4	.8		1.7			2.9	17.3
CALM								
TOTAL	3.3	27.5	58.3	10.8			100.0	13.9

NO. OF OBS: 240
MAX WIND — SPEED: 29 KNOTS; DIRECTION: 010 DEG; DAY: 23; HOUR: 15

PRECIPITATION
NO. OF DAYS WITH PRECIP: 10 NO. OF DAYS WITH REPORTS/ COMPLETE: 30 PARTIAL: 0
NO. OF OBS WITH PAST OR PRESENT PRECIP: 16 NO. OF WEATHER OBS: 240

DECEMBER — DATA SUMMARY — EB12
AVERAGE LATITUDE 26.0N — AVERAGE LONGITUDE 094.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	14.2	(01 21)	21.6	30.0	(31 21)	248	31
DEWPOINT TEMP (DEG C)	04.9	(17 18)	16.4	23.0	(27 00)	248	31
PRESSURE (MBAR)	1010.3	(06 21)	1018.6	1030.0	(01 15)	249	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		4.0	12.9	2.8			19.8	13.0
NE		7.7	4.8				12.5	10.7
E		4.8	9.2	.4			15.3	11.9
SE		2.8	16.9	1.6			21.0	15.1
S			25.0	7.3			32.3	18.2
SW		.4					.4	10.0
W			1.2				1.2	17.7
NW			2.4				2.4	17.7
CALM								
TOTAL		19.8	68.1	12.1			100.0	15.2

NO. OF OBS: 248
MAX WIND — SPEED: 30 KNOTS; DIRECTION: 340 DEG; DAY: 20; HOUR: 12

PRECIPITATION
NO. OF DAYS WITH PRECIP: 10 NO. OF DAYS WITH REPORTS/ COMPLETE: 31 PARTIAL: 0
NO. OF OBS WITH PAST OR PRESENT PRECIP: 18 NO. OF WEATHER OBS: 248

NOVEMBER — DATA SUMMARY — EB15
AVERAGE LATITUDE 32.3N — AVERAGE LONGITUDE 075.2W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	13.2	(27 00)	20.6	26.9	(05 18)	240	30
DEWPOINT TEMP (DEG C)	05.4	(27 00)	14.1	21.6	(07 06)	240	30
SEA TEMP (DEG C)	23.7	(27 00)	25.1	27.7	(05 09)	223	30
AIR-SEA TEMP (DEG C)	-10.5	(27 00)	-04.8	01.2	(02 18)	223	30
PRESSURE (MBAR)	1004.6	(21 21)	1019.1	1027.5	(16 15)	240	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		8.1	9.0	.4			17.5	12.0
NE	.4	11.1	6.0				17.5	10.3
E	.9	3.8	2.1	.9			7.7	10.0
SE	.9	3.0	.4				4.3	7.6
S	.4	3.4	12.4	1.7			17.9	14.8
SW		3.0	4.7	1.3			9.0	14.5
W	.4	2.1	5.1	4.3			12.0	16.2
NW	.4	3.8	7.3	2.6			14.1	15.1
CALM								
TOTAL	3.4	38.5	47.0	11.1			100.0	13.3

NO. OF OBS: 234
MAX WIND — SPEED: 29 KNOTS; DIRECTION: 270 DEG; DAY: 22; HOUR: 00

PRECIPITATION
NO. OF DAYS WITH PRECIP: 11 NO. OF DAYS WITH REPORTS/ COMPLETE: 30 PARTIAL: 0
NO. OF OBS WITH PAST OR PRESENT PRECIP: 15 NO. OF WEATHER OBS: 240

DECEMBER — DATA SUMMARY — EB15
AVERAGE LATITUDE 32.3N — AVERAGE LONGITUDE 075.2W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	10.7	(10 12)	18.1	23.4	(25 18)	247	31
DEWPOINT TEMP (DEG C)	04.0	(18 12)	12.3	22.0	(26 03)	248	31
SEA TEMP (DEG C)	21.8	(23 21)	23.5	25.0	(07 09)	116	17
AIR-SEA TEMP (DEG C)	-10.5	(05 18)	-04.1	00.5	(23 18)	116	17
PRESSURE (MBAR)	0999.6	(02 18)	1018.4	1032.9	(23 15)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		1.6	5.7	1.2			8.5	14.1
NE	.8	4.9	3.2				8.9	9.6
E	1.7	2.4	3.2	1.2			8.1	11.6
SE	.4	.4	2.8	1.6	.8		6.1	21.7
S	.5	2.4	11.3	4.9			19.4	17.7
SW	.4	1.2	6.5	3.6	.8		12.6	19.4
W	.4	4.9	7.3	11.3	2.4		20.3	20.2
NW	.4	1.2	6.9	1.6			10.1	16.7
CALM								
TOTAL	4.5	19.0	47.0	23.9	4.0		100.0	17.2

NO. OF OBS: 247
MAX WIND — SPEED: 41 KNOTS; DIRECTION: 150 DEG; DAY: 01; HOUR: 12

PRECIPITATION
NO. OF DAYS WITH PRECIP: 12 NO. OF DAYS WITH REPORTS/ COMPLETE: 31 PARTIAL: 0
NO. OF OBS WITH PAST OR PRESENT PRECIP: 21 NO. OF WEATHER OBS: 248

NOVEMBER — DATA SUMMARY — EB32
AVERAGE LATITUDE 27.0N — AVERAGE LONGITUDE 084.3W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	17.8	(14 00)	22.9	26.3	(06 18)	102	30
SEA TEMP (DEG C)	23.1	(30 06)	25.0	28.2	(06 18)	58	30
AIR-SEA TEMP (DEG C)	-06.2	(13 12)	-02.0	01.2	(18 18)	58	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		5.9	10.8				16.7	12.7
NE		5.9	16.7				22.5	12.3
E	1.0	21.6	11.8				34.3	9.3
SE	2.0	6.9	3.9				12.7	7.8
S		8.8	2.0				10.8	8.6
SW		1.0					1.0	6.0
W								
NW		1.0	1.0				2.0	9.0
CALM								
TOTAL	2.9	51.0	46.1				100.0	10.3

NO. OF OBS: 102
MAX WIND — SPEED: 20 KNOTS; DIRECTION: 350 DEG; DAY: 12; HOUR: 18

DECEMBER — DATA SUMMARY — EB32
AVERAGE LATITUDE 27.0N — AVERAGE LONGITUDE 084.3W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	16.0	(09 18)	20.8	24.8	(04 06)	78	28
SEA TEMP (DEG C)	20.6	(25 12)	22.2	23.4	(30 18)	58	26
AIR-SEA TEMP (DEG C)	-03.5	(10 00)	-01.2	02.3	(04 06)	53	24

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		9.5	6.2				15.7	11.8
NE	2.7	4.1	9.6				16.4	9.8
E	1.4	13.7	11.0				26.0	8.6
SE	1.4	6.8	12.3				20.5	11.5
S		4.1	4.1				8.2	10.2
SW		2.7	1.4				4.1	12.3
W								
NW		2.7	8.2				11.0	14.9
CALM								
TOTAL	5.5	39.7	54.8				100.0	10.8

NO. OF OBS: 73
MAX WIND — SPEED: 21 KNOTS; DIRECTION: 320 DEG; DAY: 17; HOUR: 18

(EB33 and EB62 continued on page 181.)

Table 13

Selected Gale and Wave Observations, North Atlantic

November and December 1974

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves† Period sec.	Sea Waves† Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.*	Swell Waves Height ft.
NORTH ATLANTIC		NOV.															
MV SYLVD	NORWEGIAN	3	40.6 N	37.6 W	18	19	50	.5 NM	81	993.0	20.8	21.0	14	19.5			
SS LOS ANGELES	AMERICAN	3	41.2 N	35.5 W	18	16	45	2 NM	60	995.3	20.0	20.0	6	11.5	15	9	16.5
SS LOS ANGELES	AMERICAN	4	41.3 N	34.6 W	00	18	48	1 NM	21	997.0	20.0	18.4	7	13	18	12	20
MV BAKAR	NORWEGIAN	9	34.7 N	18.3 W	06	32	45	5 NM	02	997.0	9.0	11.0	7	19.5			
MV CAPE FREELS	LIBERIAN	10	51.4 N	19.1 W	12	25	41	5 NM	80	1000.3	11.0		5	10			
MV CAPE FREELS	LIBERIAN	11	51.0 N	23.8 W	12	31	42	5 NM	03	1012.0	11.0		5	8			
MV CAPE FREELS	LIBERIAN	12	50.2 N	31.2 W	12	29	41	2 NM	81	997.0	9.0		3	3			
MV CAPE FREELS	LIBERIAN	13	49.4 N	36.2 W	12	33	47	5 NM	03	1010.0	8.0		5	11.5			
SS STAGHOUND	AMERICAN	13	46.1 N	27.7 W	18	31	45	10 NM	80	993.0	10.6	15.0	8	29.5			
MV WOERMANN SASSANDRA	SINGAPORE	13	47.1 N	13.5 W	00	25	41	5 NM	02	994.5	15.0	16.0	8	8	24	10	11.5
MV BARTLETT	AMERICAN	13	43.0 N	15.1 W	06	22	M 41	2 NM	81	1002.4	15.0	15.0	6	10	23	11	14.5
SS STAGHOUND	AMERICAN	14	45.6 N	28.7 W	00	31	45	10 NM	80	999.0	10.0	15.0	8	10	31	9	19.5
MV WOERMANN SASSANDRA	SINGAPORE	14	46.1 N	15.1 W	00	25	41	10 NM	16	983.5	12.0	14.0	8	10	25	11	14.5
SS ELIZABETHPORT	AMERICAN	18	38.4 N	55.2 W	18	36	64	< 50 YD	15	999.6	17.3	23.9	5	16.5			
SS PIONEER COMMANDER	AMERICAN	19	44.7 N	08.8 W	12	18	50	5 NM	01	1005.7	13.9	13.3	5	11.5	20	11	13
SS ANCHORAGE	AMERICAN	20	36.7 N	35.1 W	00	27	55	2 NM	18	999.7	19.4	21.1					
MV BAYANO	BRITISH	21	36.4 N	70.9 W	18	27	46	5 NM	16	996.5	13.6	18.0	9	19.5			
SS EXXON BOSTON	AMERICAN	21	37.7 N	72.1 W	12	27	50	10 NM	02	994.6	13.3	19.5	5	11.5			
SS FORTALEZA	AMERICAN	21	33.7 N	74.4 W	18	25	41	5 NM	02	999.2	17.2	21.6	3	8	25	9	14.5
USNS TALLULAH	AMERICAN	21	34.0 N	74.0 W	06	27	45	2 NM	13	1000.0	19.4	26.7	7	6.5			
MV UNION SUNRISE	CHINESE	21	36.0 N	70.1 W	06	20	M 48	5 NM	03	990.5	22.4	23.0					
MV BAYANO	BRITISH	22	36.3 N	66.4 W	12	28	42	5 NM	16	999.1	13.8	24.0	10	29.5			
MV BARTLETT	AMERICAN	24	42.3 N	56.9 W	00	01	M 42	5 NM	16	1005.8	10.0	16.7		14.5	XX		18
SS ANCHORAGE	AMERICAN	24	37.3 N	55.4 W	18	33	45	5 NM	16	1012.5	17.8	22.2	7	11.5	33	8	29.5
SS EXPORT LEADER	AMERICAN	24	40.0 N	52.8 W	12	36	45	5 NM	02	1003.7	16.2	22.3	6	8	36	9	19.5
SS AMER LEADER	AMERICAN	26	40.6 N	64.1 W	18	26	42	5 NM	02	999.5	11.7	20.6	6	10	26	8	19.5
SS ANCHORAGE	AMERICAN	26	39.3 N	65.8 W	18	28	45	5 NM	16	1005.8	16.7	21.1	8	14.5	27	8	19.5
SS MOBIL POWER	AMERICAN	26	37.6 N	68.3 W	12	29	45	10 NM	01	1007.8	12.3	22.8	5	6.5	25	9	11.5
SS J T HIGGINS	LIBERIAN	26	41.2 N	63.6 W	18	24	M 45	10 NM	80	1004.0	11.7	19.5	9	16.5			
SS SANTA CRUZ	AMERICAN	26	33.5 N	77.3 W	06	32	45	10 NM	02	1018.3	10.0	23.3	6	13	32	6	16.5
SS AMER LEADER	AMERICAN	27	41.4 N	62.5 W	00	26	42	5 NM	62	1001.0	8.9	18.9	6	10	26	10	18
SS EXPORT FREEDOM	AMERICAN	27	46.1 N	55.8 W	18	24	45	10 NM	02	995.0	2.0	11.8	4	6.5	24	8	14.5
SS EXPORT DEMOCRACY	AMERICAN	27	36.9 N	61.5 W	00	27	50	10 NM	01	1007.0	18.3	22.2	3	8	27	< 6	14.5
MV OLIVIA MAERSK	DANISH	27	38.9 N	62.8 W	12	27	50	2 NM	80	1011.0	7.6						
SS EXPORT FREEDOM	AMERICAN	28	45.8 N	58.1 W	00	27	45	10 NM	02	999.0	1.0		4	13	27	8	16.5
SS SEALAND MC LEAN	AMERICAN	30	45.4 N	44.8 W	06	23	55	5 NM	03	992.5	6.7	8.3	8	13			
OCEAN STATION VESSELS																	
ATLANTIC H																	
USCGC BIBB	AMERICAN	8	38.0 N	71.0 W	06	30	M 52	.5 NM	63	996.5	14.3	18.7	7	10			
USCGC BIBB	AMERICAN	21	38.0 N	71.0 W	21	29	49	5 NM	16	992.5	11.5	17.2	9	18			
USCGC BIBB	AMERICAN	22	38.0 N	71.0 W	12	32	45	5 NM	16	1002.8	6.5	17.1	10	21			
USCGC BIBB	AMERICAN	26	38.0 N	71.0 W	12	30	42	5 NM	02	1012.0	7.7	21.0	8	16.5			
GREAT LAKES VESSELS																	
SS EDMUND FITZGERALD	AMERICAN	11	48.1 N	87.9 W	18	36	M 42	5 NM	63		3.0	5.0	8	13			
SS LEON FALK JR	AMERICAN	16	41.6 N	82.3 W	00	24	M 46	10 NM	02		1.0	9.0	4	5			
SS CASAN J CALLAWAY	AMERICAN	21	41.8 N	82.5 W	00	27	M 42	5 NM	50		6.0	1.0	3	6.5			
SS J L MAUTHE	AMERICAN	21	43.7 N	82.5 W	12	35	M 42	5 NM	21		3.0	8.0					
NORTH ATLANTIC		DEC.															
SS EXPORT CHALLENGER	AMERICAN	1	37.0 N	73.8 W	18	12	42	2 NM	62	1004.4	15.9	17.8	5	13			
SS JACKSONVILLE	AMERICAN	1	34.3 N	72.6 W	18	13	45	1 NM	59	1004.4	18.9	25.5	4	8	09	< 6	8
SS TEXACO MISSISSIPPI	AMERICAN	1	35.0 N	73.3 W	18	17	45	.25 NM	63	1001.4	19.8	22.8	5	5	17	6	23
SS SUCONY VACUUM	AMERICAN	1	29.8 N	77.6 W	12	27	42	5 NM	82	1007.1	21.1	25.0	10	11.5	16	9	26
SS VALLEY FORGE	AMERICAN	1	34.7 N	75.0 W	06	13	45	5 NM	02	1012.0	18.3	25.0			13	10	11.5
SS AMER ACE	AMERICAN	1	48.4 N	29.4 W	12	25	45	10 NM	03	999.7	13.5	13.5	4	10	25	6	16.5
SS BOSTON	AMERICAN	1	33.9 N	74.9 W	12	14	48	5 NM	02	1004.4	18.8	23.3	5	16.5	16	12	24.5
SS EXPORT CHALLENGER	AMERICAN	2	38.2 N	73.8 W	00	07	45	2 NM	64	1001.0	17.3	16.7	5	14.5	09	7	19.5
SS EXPORT AIDE	AMERICAN	2	36.5 N	66.1 W	12	13	73	2 NM	50	1000.3	20.0	22.2			12	12	39
SS MOBIL LUBE	AMERICAN	2	38.0 N	72.2 W	00	07	49	1 NM	52	1001.4	15.6	17.8	9	14.5			
SS OCEANIC	PANAMANIAN	2	33.3 N	70.0 W	00	16	M 45	5 NM	62	1005.5	20.0	23.3	6	13			
SS AMER ARGOSY	AMERICAN	2	37.0 N	74.4 W	00	13	50	2 NM	21	999.7	15.0	13.1	6	13	13	< 6	16.5
SS EXPORT AIDE	AMERICAN	3	36.0 N	66.8 W	00	26	65	2 NM	50	996.6	18.9	22.2			24	13	31
SS ELMER R PETERSON	LIBERIAN	3	33.0 N	66.1 W	06	27	45	10 NM	02	1002.0	16.7	23.5	5	13	27	6	19.5
SS EXPORT AIDE	AMERICAN	4	38.8 N	73.0 W	06	31	60	10 NM	02	1005.0	7.7	17.3			29	13	36
SS ELMER R PETERSON	LIBERIAN	4	36.1 N	71.2 W	18	29	42	10 NM	02	1011.0	11.1	22.8	5	13	29	6	16.5
SS NORMACLYNX	AMERICAN	8	28.3 N	60.0 W	00	03	45	.5 NM	82	1013.0	19.5	25.1	4	11.5			
SS OVERSEAS JUNEAU	AMERICAN	14	29.4 N	47.4 W	18	07	45	5 NM	80	990.2	23.3	21.1	5	8	06	6	11.5
SS SEALAND RESOURCE	AMERICAN	15	38.3 N	65.3 W	18	34	45	10 NM	07	1018.5	10.6	14.0	7	11.5	34	8	14.5
SS MOBIL AERO	AMERICAN	15	28.3 N	78.6 W	18	15	41	200 YD	64	1011.5	21.3	22.3	7	10	15	9	19.5
SS MITRA	NORWEGIAN	16	42.0 N	59.0 W	12	35	47	5 NM	50	1023.0	7.0	15.0	6	11.5	35	6	14.5
MV CORSICANA	LIBERIAN	16	38.1 N	50.6 W	12	29	M 45	5 NM	02	1013.0	15.0	20.0					
SS AMER LEADER	AMERICAN	16	42.4 N	55.5 W	18	34	45	5 NM	02	1006.5	7.7	16.1	4	10	34	6	29.5
SS BALTIMORE TRADER	AMERICAN	16	35.3 N	73.4 W	18	13	45	5 NM	02	1006.1	19.0	22.2	5	11.5	15	6	14.5
SS SEALAND VENTURE	AMERICAN	17	36.2 N	46.1 W	12	28	46	10 NM	02	1008.8	17.2	20.6			28	7	11.5
SS GOLDEN DOLPHIN	AMERICAN	17	35.0 N	43.7 W	18	28	45	10 NM	02	1009.8	15.6	18.8	6	11.5			
MV CORSICANA	LIBERIAN	17	38.2 N	52.4 W	06	31	M 55	5 NM	80	1015.5	14.0	21.0					
SS AMER ARGOSY	AMERICAN	17	46.4 N	27.6 W	12	27	45	5 NM	27	1009.2	7.2	12.8	10	23			
SS ORE METEOR	LIBERIAN	18	35.8 N	72.7 W	12	32	45	2 NM	27	1011.2	11.4	22.2	6	13	32	10	14.5
SS LASH ESPANA	AMERICAN	18	36.7 N	28.4 W	06	16	44	1 NM	63	1011.4	16.1	17.8					
SS AMER EAGLE	AMERICAN	18	32.6 N	66.8 W	21	30	48	10 NM	01	1015.9	15.6	22.4	3	8	27	9	29.5
SS AMER ARGOSY	AMERICAN	18	45.9 N	33.1 W	18	26	45	5 NM	01	1004.8	11.1	13.3					
SS OTTO N MILLER	LIBERIAN	18	34.1 N	71.3 W	12	26	45	2 NM	82	1008.0	15.0	21.0			26		8
SS ERIC K HOLZER	AMERICAN	18	31.6 N	70.4 W	12	27	45	10 NM	03	1012.7	16.7	20.0	7	14.5			
SS EXPORT BAY	AMERICAN	18	37.0 N	63.7 W	18	27	55	1 NM	82	998.3	15.0	22.2	6	10	27	>13	19.5
MV CORSICANA	LIBERIAN	18	38.5 N	38.5 W	12	19	M 55	2 NM		1002.5	21.0	21.0	XX	10	21	X	36
SS EXPORT BAY	AMERICAN	19	37.1 N	65.4 W	00	28	45	5 NM	80	1008.5	14.0	21.7	5	10	28	< 6	13

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves* Period sec.	Sea Waves* Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.*	Swell Waves Height ft.
NORTH ATLANTIC OCEAN		DEC.															
SS GOLDEN DOLPHIN	AMERICAN	19	38.3 N	48.1 W	00	23	50	10 NM	02	1007.1	19.0	18.0	6	11.5			
MV CORSICANA	LIBERIAN	19	38.7 N	61.2 W	06	27	M 65	2 NM	13	1012.5	12.0	20.5					
MV CORSICANA	LIBERIAN	19	38.5 N	62.0 W	12	28	M 40	5 NM	03	1019.0	13.5	20.5			30	X	32.5
SS AMER ARGOSY	AMERICAN	20	47.1 N	20.2 W	12	23	48	5 NM	51	997.3	11.0	13.0	4	16.5	23	6	19.5
SS AMER ACCORD	AMERICAN	20	45.4 N	38.5 W	18	29	45	10 NM	02	998.8	8.8	15.6	6	13	28	7	16.5
SS GOLDEN DOLPHIN	AMERICAN	20	40.7 N	52.1 W	06	29	45	10 NM	50	1011.9	11.0	14.0	5	16.5			
MV BERGLJOT	NORWEGIAN	20	46.9 N	40.8 W	12	26	M 35	2 NM		989.5	7.5	16.0	8	19.5			
SS AMER ARGOSY	AMERICAN	21	46.7 N	27.8 W	12	27	48	10 NM	01	992.6	10.5	13.5	4	24.5	27	6	32.5
SS CHEVRON LIEGE	PANAMANIAN	21	38.6 N	36.9 W	18	28	48	2 NM	25	1003.5	15.0	17.8	8	16.5			
SS LASH ESPANA	AMERICAN	22	36.6 N	57.9 W	06	23	46	10 NM	02	1010.5	20.0	20.6	5	6.5			
SS LASH ESPANA	AMERICAN	23	36.8 N	63.8 W	00	29	35	10 NM	62	1009.7	11.7	20.0			27	7	18
SS CHEVRON LIEGE	PANAMANIAN	23	39.9 N	44.4 W	12	26	45	2 NM	29	997.5	19.4	18.8	4	11.5	26	6	16.5
SS ELIZABETHPORT	AMERICAN	23	35.8 N	54.0 W	18	27	45	2 NM	25	1008.5	15.0	22.8	12	28			
SS AMER ARGOSY	AMERICAN	23	43.5 N	49.3 W	18	07	50	5 NM	20	984.8	1.1	4.4	6	24.5			
SS CHEVRON LIEGE	PANAMANIAN	24	40.3 N	46.6 W	06	29	56	.25 NM	65	976.5	9.7	16.7			26	9	26
SS AMER ARGOSY	AMERICAN	24	39.6 N	39.5 W	18	32	50	5 NM	20	1003.1	8.9	16.1	5	24.5			
SS ELIZABETHPORT	AMERICAN	24	33.7 N	54.1 W	00	31	45	2 NM	16	1013.9	14.4	22.2	8	16.5			
SS AMER ARGOSY	AMERICAN	24	43.0 N	53.2 W	00	33	45	5 NM	02	1002.7	2.7	5.4	6	24.5	01	8	32.5
SS ROY G LUCKS	LIBERIAN	25	35.9 N	69.0 W	18	23	44	2 NM	80	1003.0	20.0	20.0	7	24.5	23	7	29.5
SS CHEVRON LIEGE	PANAMANIAN	25	40.6 N	49.0 W	00	26	47	1 NM		997.5	15.0	14.5	7	10	26	9	16.5
SS AMER ACE	AMERICAN	25	48.4 N	14.9 W	18	23	50	2 NM		1001.0	13.9	12.8	7	19.5			
MV ATLANTIC CARRIER	LIBERIAN	25	38.2 N	53.7 W	12	32	42	5 NM	02	1007.0	14.0	18.0	9	16.5			
SS ROY G LUCKS	LIBERIAN	26	37.5 N	72.3 W	12	20	45	5 NM	03	1017.0	6.0	16.7	7	24.5	20	7	29.5
MV ATLANTIC CARRIER	LIBERIAN	26	36.5 N	47.7 W	18	23	30	2 NM		1001.0	20.0	17.9	9	18			
SS CHEVRON LIEGE	PANAMANIAN	26	41.6 N	56.0 W	12	32	50	2 NM		987.5	8.0	15.5	XX	14.5			
SS WILLIAM M ALLEN	LIBERIAN	26	35.4 N	62.6 W	06	30	37	5 NM	06	1002.4	17.2	20.0					
SS AMER ACE	AMERICAN	26	48.6 N	20.0 W	18	25	50	2 NM		1002.7	10.6	13.3	6	19.5			
SS AMER LEADER	AMERICAN	26	43.4 N	41.1 W	12	15	47	2 NM	65	985.0	12.5	18.3	5	10	15	7	16.5
SS ELIZABETHPORT	AMERICAN	26	37.9 N	64.1 W	06	31	50	1 NM	32	996.6	15.0	23.3	12	26			
SS ULTRASEA	AMERICAN	27	49.8 N	05.8 W	12	27	45	2 NM		1020.0	12.2	11.1	7	16.5	26	12	26
SS WILLIAM M ALLEN	LIBERIAN	27	36.3 N	64.1 W	00	31	43	10 NM	03	1021.0	9.4	21.1	10	14.5			
SS AMER LEGACY	AMERICAN	27	47.5 N	19.9 W	18	22	35	2 NM		1015.5	16.8	12.3	4	14.5	23	9	34.5
SS AMER ACE	AMERICAN	27	48.6 N	20.7 W	00	26	45	10 NM	03	1009.1	11.5	13.0	5	13	26	6	16.5
SS AMER LEGACY	AMERICAN	27	49.3 N	17.5 W	00	27	45	2 NM	07	1008.2	11.7	12.2	8	14.5	26	10	24.5
SS AMER ACE	AMERICAN	29	47.1 N	39.6 W	18	26	45	5 NM	25	998.0	14.4	15.6	5	8	18	7	11.5
OCEAN STATION VESSELS																	
ATLANTIC H																	
USCGC TANEY	AMERICAN	2	38.0 N	71.0 W	00	11	31	2 NM	61	1006.0	16.4	16.1	7	13			
USCGC INGHAM	AMERICAN	17	38.0 N	71.0 W	00	16	M 48	2 NM	61	1004.0	17.1	18.3	8	13			
USCGC INGHAM	AMERICAN	26	38.0 N	71.0 W	03	33	M 46	5 NM	02	1008.8	9.9	14.6	8	16.5			
GREAT LAKES VESSELS																	
SS CHARLES M WHITE	AMERICAN	1	41.7 N	82.0 W	18	06	M 48	5 NM	83		2.0	8.0	14	14.5			
SS JOHN DYKSTRA	AMERICAN	2	45.1 N	81.8 W	18	03	M 42	10 NM	01		1.0	6.0	2	6.5			
SS JOHN DYKSTRA	AMERICAN	8	46.9 N	85.9 W	06	35	M 44	2 NM	88		- 2.0	4.0		8			
SS ERNEST R BREECH	AMERICAN	8	47.9 N	89.4 W	06	36	M 45	5 NM	01		-12.0	4.0	7	8			
SS CHARLES M BEEGHLY	AMERICAN	8	47.4 N	86.8 W	06	36	M 42	10 NM	02		- 7.0	5.0	6	6.5			
SS JOHN DYKSTRA	AMERICAN	16	47.7 N	87.9 W	00	10	M 44	1 NM	73		- 2.0	3.0		14.5			
SS CLIFFS VICTORY	AMERICAN	26	45.7 N	85.7 W	18	22	M 42	10 NM	03		- 3.0	3.0	5	10			
SS ASHLAND	AMERICAN	27	44.6 N	82.9 W	00	20	M 42	> 25 NM	03		- 3.0	3.0	2	6.5			

* Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 kt or waves ≥ 25 ft from May through August (≥ 41 kt or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest wind speed was selected.

(Continued from page 179.)

NOVEMBER DATA SUMMARY E033
AVERAGE LATITUDE 39.9N AVERAGE LONGITUDE 141.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-00.1	(20 03)	05.4	09.0	(03 06)	227	30
SEA TEMP (DEG C)	06.2	(30 15)	07.0	07.7	(14 00)	207	30
AIR-SEA TEMP (DEG C)	-07.1	(20 03)	-01.4	01.8	(03 06)	204	30
PRESSURE (MBAR)	0979.5	(06 18)	0998.0	1025.0	(13 00)	203	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.0	.5	2.0				3.4	10.6
NE	.5	.5	1.0				2.0	8.5
E	1.0	2.4	6.8	4.4			14.6	16.1
SE		7.3	21.0	5.9			34.1	15.9
S		7.3	12.7	2.9			22.9	13.8
SW	.5	4.4	4.4	1.0			10.2	12.4
W		2.9	5.4	1.5			9.8	13.3
NW	1.0	1.0					2.0	5.3
CALM	1.0						1.0	.0
TOTAL	4.9	26.3	53.2	15.6			100.0	14.2

NO. OF OBS: 205

MAX WIND
SPEED: 34 KNOTS
DIRECTION: 110 DEG
DAY: 22
HOUR: 06

DECEMBER DATA SUMMARY E033
AVERAGE LATITUDE 38.5N AVERAGE LONGITUDE 141.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-01.2	(27 15)	04.9	07.3	(07 21)	233	31
SEA TEMP (DEG C)	05.9	(19 18)	06.9	07.1	(27 00)	233	31
AIR-SEA TEMP (DEG C)	-08.1	(27 15)	-02.2	01.2	(07 21)	233	31
PRESSURE (MBAR)	0962.5	(31 09)	0993.4	1017.1	(22 09)	224	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.9	2.6	.9				4.3	6.7
NE	.4	2.6	3.0				6.1	10.6
E	.9	4.3	8.2	4.8	.4		18.6	16.3
SE	.4	4.8	11.7	3.0			19.9	14.1
S		4.3	8.2	1.7			14.3	14.1
SW		1.7	10.0	4.3			16.0	16.6
W	.4	2.6	13.9	2.2			19.0	15.6
NW		.4	.4	.4			1.3	16.0
CALM	.4						.4	.0
TOTAL	3.5	23.4	56.3	16.5	.4		100.0	14.6

NO. OF OBS: 231

MAX WIND
SPEED: 34 KNOTS
DIRECTION: 110 DEG
DAY: 16
HOUR: 03

NOVEMBER DATA SUMMARY E062
AVERAGE LATITUDE 29.0N AVERAGE LONGITUDE 089.6W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	12.5	(26 12)	19.9	24.8	(19 18)	92	23
SEA TEMP (DEG C)	22.1	(30 18)	23.7	24.9	(08 06)	91	23
AIR-SEA TEMP (DEG C)	-10.2	(26 12)	-03.7	00.7	(20 18)	91	23
PRESSURE (MBAR)	1010.2	(30 18)	1019.6	1024.1	(16 12)	91	23

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.1	5.4	8.7	2.2			17.4	14.2
NE		7.6	12.0				19.6	11.4
E		7.6	13.0				20.7	12.1
SE		2.2	10.9	1.1			14.1	14.0
S	1.1	4.3	6.5				12.0	10.0
SW				1.1			1.1	24.0
W			2.2	1.1			3.3	17.4
NW		2.2	9.8				12.0	14.8
CALM								
TOTAL	2.2	29.3	63.0	5.4			100.0	13.0

NO. OF OBS: 92

MAX WIND
SPEED: 25 KNOTS
DIRECTION: 150 DEG
DAY: 30
HOUR: 12

DECEMBER DATA SUMMARY E062
AVERAGE LATITUDE 29.0N AVERAGE LONGITUDE 089.6W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	10.1	(01 12)	17.9	25.0	(29 18)	123	31
SEA TEMP (DEG C)	20.5	(24 12)	21.7	23.1	(30 18)	122	31
AIR-SEA TEMP (DEG C)	-11.9	(01 12)	-03.4	02.9	(29 18)	122	31
PRESSURE (MBAR)	1009.4	(07 18)	1019.8	1028.5	(27 12)	123	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		2.4	5.7				8.1	12.7
NE		1.6	6.5				8.1	12.6
E	1.6	5.7	12.2				19.5	11.6
SE		.8	13.0	.8			14.6	15.7
S		3.3	4.1	4.1			11.4	16.7
SW	2.4	3.3	3.3				8.9	8.2
W	1.6	.8	10.6	1.6			14.6	13.5
NW		3.3	10.6	.8			14.6	14.1
CALM								
TOTAL	5.7	21.1	65.9	7.3			100.0	13.6

NO. OF OBS: 123

MAX WIND
SPEED: 27 KNOTS
DIRECTION: 170 DEG
DAY: 19
HOUR: 18

Table 14
Selected Gale and Wave Observations, North Pacific
November and December 1974

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves Period sec.	Sea Waves Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.*	Swell Waves Height ft.
NORTH PACIFIC		NOV.															
MV EASTERN BUILDER	LIBERIAN	1	39.6 N	149.5 E	12	29	M 60	2 NM		1006.0	12.0	12.0	7	11.5	29	< 6	14.5
MV WAY WAY	LIBERIAN	1	44.6 N	153.0 E	12	23	M 50	2 NM	89	986.0	6.2	16.0	3	16.5	23	13	41
SS OREGON MAIL	AMERICAN	2	45.8 N	155.7 E	12	28	45	5 NM	25	1003.0	5.6	2.8	7	13	27	9	29.5
SS SEATRAIN FLORIDA	AMERICAN	2	20.4 N	124.5 E	18	07	39	2 NM		1010.8	25.0	27.8	8	24.5	01	8	32.5
MV EASTERN BUILDER	LIBERIAN	2	39.0 N	147.7 E	00	29	M 35	10 NM	01	1016.0	14.0	14.0	5	13			
MV ASIA BRAVERY	LIBERIAN	2	52.7 N	170.6 E	00	12	M 42	1 NM	63	994.0	4.0	7.0	5	10	18	6	21
SS SEALAND FINANCE	AMERICAN	2	45.5 N	156.0 E	06	30	35	5 NM	81	992.8	6.2	5.5	3	8	30	8	32.5
MV WAY WAY	LIBERIAN	2	44.0 N	152.0 E	00	27	M 55	5 NM	01	999.0	10.0	14.0	4	19.5	27	>13	49
SS PHIL MAIL	AMERICAN	3	52.4 N	138.5 W	00	16	45	5 NM	80	999.3	12.8	10.6	3	11.5	17	6	14.5
MV ROBERTS BANK	LIBERIAN	3	08.4 N	140.6 E	06	16	48	2 NM	82	1002.9	28.7	29.0	6	8			
SS EXXON NEWARK	AMERICAN	3	57.8 N	148.5 W	00	02	45	2 NM	80	976.9	5.5	6.0	7	23	08	8	16.5
MV STAR BILLABONG	LIBERIAN	3	49.5 N	179.9 E	06	25	41	5 NM	02	981.0	9.0	6.0	6	19.5			
MV HONGKONG CONTAINER	LIBERIAN	4	43.0 N	177.9 W	06	28	M 47	2 NM		1007.5	11.0	14.0	4	41	26	9	39
MV HONSHU MARU	JAPANESE	5	48.8 N	169.3 E	12	13	M 47	.25 NM	07	988.5	6.0	6.5	7	14.5			
SS FREDERICK LYKES	AMERICAN	5	15.5 N	131.7 E	00	32	60 (O)	.25 NM	65	983.4	25.5	27.8			05	11	29.5
MV HAKONE MARU	JAPANESE	6	38.1 N	179.9 W	06	19	M 45	5 NM	02	1012.5	17.0	18.0			19	7	13
MV STAR BILLABONG	LIBERIAN	6	45.7 N	163.6 E	06	27	40	5 NM	03	1003.0	7.0	4.0		32.5	27	X	49
SS AMER AQUARIUS	AMERICAN	6	39.7 N	179.1 E	03	18	30	5 NM	03	1008.8	14.4	11.7	6	13			
MV HONSHU MARU	JAPANESE	7	49.7 N	170.7 W	18	26	M 45	5 NM	80	979.0	3.3	7.0	8	6.5	25	>13	13
SS WASHINGTON MAIL	AMERICAN	7	49.6 N	160.3 W	18	23	45	5 NM	93	985.2	6.7	8.3	7	24.5			
SS SANTA MARIA	AMERICAN	8	58.7 N	151.6 W	12	11	41	5 NM	02	974.9	7.2	9.0					
MV SYUKO MARU	JAPANESE	8	46.4 N	173.0 W	00	27	M 38	1 NM	21	1003.0	6.0	5.0	8	16.5	27	10	32.5
MV HONSHU MARU	JAPANESE	8	49.7 N	168.4 W	00	29	M 43	5 NM	02	981.5	5.5	7.0	8	6.5	28	>13	13
SS WASHINGTON MAIL	AMERICAN	8	50.4 N	148.9 W	18	26	45	5 NM	02	993.0	7.8	8.9	6	19.5	25	7	23
MV VAN CONQUEROR	LIBERIAN	8	47.9 N	163.3 W	12	27	M 30	5 NM	02	998.0	8.0	8.0					
MV SYUKO MARU	JAPANESE	9	49.0 N	163.2 W	06	27	M 32	2 NM		1005.0	7.0	5.0	7	14.5	27	10	32.5
MV GOLDEN EXPLORER	LIBERIAN	9	49.7 N	168.6 E	06	19	M 43	5 NM	61	1008.2	7.0	8.0	5	11.5	20	8	16
SS PHIL MAIL	AMERICAN	9	46.8 N	156.2 E	06	26	45	10 NM	02	1001.4	3.3	5.6	5	14.5	26	< 6	16
SS INDIAN MAIL	AMERICAN	10	49.5 N	172.8 E	18	18	48	2 NM	04	989.8	8.3	5.6	8	10	18	8	16
SS EXPORT CHALLENGER	AMERICAN	10	33.7 N	178.5 W	12	10	30	5 NM	25	1011.2	16.2	20.0	5	10	09	6	24.5
MV CECILIE MAERSK	DANISH	10	37.5 N	177.4 E	18	11	47	10 NM	00	1011.3	16.0	18.0	6	16.5			
MV DAPHNE	SWEDISH	10	34.1 N	173.0 W	18	11	45	1 NM	83	1020.0	16.5	21.0	8	21			
MV THOMAS MAERSK	DANISH	10	40.0 N	167.4 E	06	17	47	5 NM	02	1005.0	16.4		7	8	17	>13	13
MV TOYOTA MARU #8	JAPANESE	10	34.5 N	170.5 W	18	10	M 44	1 NM	65	1014.8	17.0	16.5	6	11.5	09	11	14.5
MV HONSHU MARU	JAPANESE	11	49.3 N	137.4 W	18	01	M 43	2 NM		1007.0	10.0	10.5	7	13			
SS PHIL MAIL	AMERICAN	11	39.0 N	144.6 E	00	29	45	10 NM	03	1017.9	10.0	17.8	3	11.5			
SS SANTA MARIA	AMERICAN	11	48.6 N	128.9 W	12	14	45	10 NM	60	1007.8	10.0	13.4					
MV VAN CONQUEROR	LIBERIAN	11	47.8 N	177.9 E	06	16	M 53	2 NM	18	982.0	9.0	8.0					
MV SANKOGRAIN	LIBERIAN	11	51.7 N	179.9 W	12	27	M 50	200 YD		975.0	4.6	7.0			27	10	19.5
SS OREGON	AMERICAN	12	37.7 N	159.0 E	00	22	45	10 NM	07	1012.5	19.0	20.0	7	13	22	12	19.5
MV VAN CONQUEROR	LIBERIAN	12	45.9 N	168.5 E	18	27	M 45	5 NM	18	1001.0	5.0	7.0					
MV SYUKO MARU	JAPANESE	12	49.6 N	138.6 W	06	03	M 22	2 NM		1019.5	11.0	8.0	9	14.5	03	11	32.5
FICUS	PANAMANIAN	13	46.7 N	175.7 E	06	26	M 48	1 NM		1009.5	5.2	7.0	7	11.5			
MV JAPAN ACE	JAPANESE	14	39.7 N	147.8 W	06	04	M 44	2 NM	20	1019.0	13.0	13.0	3	10	03	7	13
SS PRES TAFT	AMERICAN	14	37.2 N	145.7 W	00	20	45	2 NM	62	1004.0	15.6	17.2	XX	13	20	9	24.5
SS HILLYER BROWN	AMERICAN	15	57.2 N	142.6 W	00	21	60	5 NM	01	989.5	6.1	7.2					
SS J H TUTTLE	AMERICAN	15	58.5 N	148.0 W	18	28	45	5 NM	02	991.3	3.3	6.2	5	10	28	8	29.5
SS PORTLAND	AMERICAN	15	55.9 N	142.0 W	00	21	55	2 NM	10	997.6	8.0	9.0			21	7	13
MV TUGELA	NORWEGIAN	16	47.2 N	158.7 W	12	28	45	5 NM	03	1006.0	9.0	10.0	10	19.5			
MV GOLDEN RAY	LIBERIAN	16	48.9 N	161.2 W	18	30	M 35	2 NM		1009.0	7.0	8.0	5	11.5	30	11	32.5
SS J H TUTTLE	AMERICAN	16	58.5 N	148.5 W	00	29	45	2 NM		1000.0	3.3	6.1	5	13	28	8	32.5
FICUS	PANAMANIAN	16	46.8 N	156.0 W	18	28	M 55	< 50 YD		1001.0	7.0	9.0	7	11.5			
SS HILLYER BROWN	AMERICAN	16	56.3 N	139.0 W	06	28	45	2 NM	90	1009.0	5.0	8.9	4	19.5	27	10	19.5
MV MONTIGNY	LIBERIAN	16	46.8 N	109.5 W	03	28	M 57	1 NM	07	1008.8	7.0	11.5	11	23			
SS WASHINGTON MAIL	AMERICAN	17	54.0 N	140.0 W	06	09	30	10 NM	02	984.2	7.2	8.9	6	14.5	09	9	23
MV GOLDEN RAY	LIBERIAN	17	48.7 N	162.1 W	00	30	M 35	2 NM		1019.0	8.5	7.0	5	11.5	30	11	32.5
FICUS	PANAMANIAN	17	46.5 N	153.2 W	00	28	M 42	200 YD	18	1005.5	9.5	10.0	7	11.5			
SS OREGON	AMERICAN	17	46.6 N	145.9 W	00	25	45	5 NM	02	998.6	11.1	8.9	7	16.5			
SS AMER APOLLO	AMERICAN	18	37.6 N	158.3 E	18	18	45	5 NM	02	1006.5	20.6	22.3	4	10	18	< 6	19.5
MV PLUTOS	GERMAN	18	40.4 N	153.1 E	06	14	60	1 NM	65	1000.1	15.0				XX		19.5
SS AMER APOLLO	AMERICAN	19	37.8 N	159.8 E	00	20	41	2 NM	07	1007.8	21.7	22.7	6	19.5	15	6	24.5
MV EASTERN BUILDER	LIBERIAN	19	40.1 N	167.3 E	00	19	M 50	5 NM	07	1017.5	16.0	16.0	4	8	19	8	13
SS NANCY LYKES	AMERICAN	19	34.1 N	147.9 E	00	32	47	10 NM	01	1013.2	19.4	24.4	2	16.5	32	>13	32.5
MV ASIA LOYALTY	LIBERIAN	20	49.2 N	164.3 E	00	27	60	5 NM	05	994.0	8.0	7.0	7	19.5	XX	X	23
MV CHALMETTE	LIBERIAN	20	48.2 N	173.4 W	00	19	50	2 NM	50	1011.6	8.0	6.0	6	6.5			
SS HILLYER BROWN	AMERICAN	20	45.5 N	126.7 W	18	18	45	2 NM	81	991.0	13.3	13.9	4	14.5	18	6	23
SS WASHINGTON MAIL	AMERICAN	20	53.6 N	178.3 W	18	28	45	5 NM	27	984.5	3.0	3.5	7	24.5			
FICUS	PANAMANIAN	21	40.5 N	128.5 W	00	18	M 44	50 YD	65	999.3	13.8	15.0	5	8			
SS WASHINGTON MAIL	AMERICAN	21	53.2 N	179.2 W	00	25	48	5 NM	21	984.2	5.0	5.5	7	24.5			
SS MOBILE	AMERICAN	22	54.9 N	138.0 W	00	16	45	.5 NM	62	985.0	5.6	6.3	7	19.5			
MV TROLL RIVER	BRITISH	23	23.6 N	175.3 W	18	05	44	10 NM	16	1014.1	23.4		4	16.5	09	< 6	13
MV TOWER BRIDGE	SINGAPORE	23	48.0 N	178.9 W	12	17	M 45	1 NM	65	991.0	6.3	8.0	5	16.5	17	13	24.5
SS WASHINGTON MAIL	AMERICAN	23	46.6 N	158.5 E	18	29	45	5 NM	02	1010.0	3.3	3.0	5	10	29	8	24.5
SS HAWAIIAN PROGRESS	AMERICAN	24	33.7 N	134.7 W	18	31	M 42	10 NM	02	1021.0	17.2	18.9	5	6.5			
MV VAN ENTERPRISE	LIBERIAN	24	50.0 N	166.9 W	00	13	M 47	5 NM	81	1000.0	6.0	5.0	6	10	13	10	11.5
SS ALASKAN MAIL	AMERICAN	24	54.2 N	171.7 W	00	14	50	.5 NM	44	985.8	1.7	3.0	4	8	14	10	24.5
SS JAPAN MAIL	AMERICAN	25	41.1 N	175.0 E	18	25	45	2 NM		980.0	12.3	10.6	7	18	25	9	29.5
MV MARITIME VICTOR	PANAMANIAN	25	51.9 N	173.6 E	12	27	45	2 NM	07	980.0	2.0	1.0	9	21			
MV SPORD	NORWEGIAN	25	50.4 N	177.3 W	00	29	42	5 NM	83	995.0	4.0	4.0			26	10	26
SS SEALAND COMMERCE	AMERICAN	25	42.2 N	171.9 E	18	01	45	5 NM	80	988.8	7.2	12.2	5	8	01	8	13
MV EASTERN BUILDER	LIBERIAN	26	49.5 N	141.5 W	00	18	M 44	1 NM	61	998.5	9.0	8.0	5	5	18	7	11.5
MV HONSHU MARU	JAPANESE	26	48.6 N	171.3 E	06	31	M 32	1 NM	07	1002.5	3.0	4.5	8	11.5	31	13	26
MV MARITIME VICTOR	PANAMANIAN	26	51.5 N	171.0 E	06	32	32	2 NM	07	992.0	3.0	1.0	9	29.5			
MV OLGA TOPIC	LIBERIAN	26	47.2 N	170.5 E	00	32	35	5 NM	15	1002.5	4.0	6.0	14	13			
MV ORIENTAL DESTINY	LIBERIAN	26	37.2 N	175.6 W	06	27	30	5 NM	81	1001.0	14.0	15.0	15	32.5	27	>13	36
SS JAPAN MAIL	AMERICAN	26	41.6 N	177.2 E	00	30	30	.5 NM	07	983.7	6.7	12.3	7	16.5	30	9	37.5
MV JAPAN ACE	JAPANESE	26	34.9 N	169.7 W	12	28	M 44	2 NM		1006.3	17.0	18.0	4	8	28	8	10
SS GREEN PORT	AMERICAN	26	35.6 N	173.0 W	18	32	35	10 NM	01	1011.9	14.0	17.3	5	16.5	30	8	32.5
SS JAPAN MAIL	AMERICAN	26	41.1 N	178.6 E	06	30	35	.5 NM	07	1000.3	7.3	12.3	8	19.5	31	12	29.5

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves Period sec.	Sea Waves Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.	Swell Waves Height ft.
NORTH PACIFIC OCEAN		NOV.															
SS SEALAND COMMERCE	AMERICAN	26	42.2 N	174.0 E	00	31	30	5 NM	01	1001.0	7.8	9.4	4	8	31	12	21
SS AMER ASTRONAUT	AMERICAN	26	39.1 N	170.2 E	00	35	30	10 NM	01	1016.0	8.3	14.0	6	16.5	35	8	19.5
SS EXXON NEWARK	AMERICAN	27	53.7 N	141.1 W	18	16	48	1 NM	63	999.3	8.0	7.6	3	36			
MV ORIENTAL DESTINY	LIBERIAN	27	36.9 N	179.3 W	00	32	40	10 NM	02	1017.3	14.0	16.7	10	18	30	13	32.5
SS PRES JEFFERSON	AMERICAN	27	24.6 N	120.1 E	06	01	45	5 NM	01	1011.9	21.1	22.8	3	13	02	8	13
MV JAPAN ACE	JAPANESE	27	35.0 N	172.5 W	00	31	M 22	2 NM		1015.0	16.0	18.0	6	8	32	12	32.5
SS GREEN PORT	AMERICAN	27	34.9 N	169.2 W	06	32	20	10 NM	02	1016.9	14.4	17.8	5	10	32	8	32.5
SS MOBILE	AMERICAN	27	57.7 N	145.7 W	18	14	44	2 NM	21	984.8	6.7	6.7	4	19.5	14	X	36
MV TROPHY	PANAMANIAN	27	52.8 N	162.9 W	00	03	M 47	.25 NM	58	966.7	4.8	7.0	10	14.5			
SS HAWAII	AMERICAN	29	43.1 N	160.0 W	12	12	30	2 NM	63	981.0	10.0	10.0	7	21			
MV KASHU MARU	JAPANESE	29	39.2 N	159.8 W	06	13	M 42	2 NM	63	1000.5	14.0	12.5	7	6.5	13	9	10
SS COLORADO	AMERICAN	30	33.1 N	171.4 E	12	18	45	2 NM	07	989.0	21.7	19.4	6	10			
SS JOHN LYKES	AMERICAN	30	32.6 N	171.6 E	06	19	30	5 NM	03	993.2	20.0	23.2			19	< 6	10
SS HAWAII	AMERICAN	30	42.7 N	160.3 W	00	28	30	2 NM	27	996.3	8.9	10.6	8	21	28	8	32.5
MV SPERO	NORWEGIAN	30	41.8 N	150.0 E	12	30	45	5 NM	83	1004.5	1.0	4.0			30	X	24.5
NORTH PACIFIC		DEC.															
MV ASIA BRAVERY	LIBERIAN	1	43.8 N	179.9 W	06	10	M 34	2 NM		973.8	11.0	9.0	5	10	10	7	14.5
SS GEORGE A DAVIDSON	LIBERIAN	1	53.3 N	160.9 W	00	05	45	10 NM	15	1005.5	5.5	6.7	5	19.5	XX		26
MV MIDAS SEINE	LIBERIAN	1	37.5 N	147.9 E	00	32	M 47	5 NM	16	1013.7	7.0	17.0	7	10	32	11	19.5
SS WASHINGTON MAIL	AMERICAN	2	41.4 N	168.5 E	18	27	30	5 NM	01	991.5	3.6	12.8	6	10	27	8	26
SS JOHN LYKES	AMERICAN	3	33.7 N	153.2 E	00	23	45	1 NM	21	1002.2	16.7	22.2	5	14.5	29	7	19.5
MV PAN ASIA	PANAMANIAN	3	54.6 N	178.0 E	06	06	M 45	200 YD	45	1008.6	3.0	12.0			06	7	32.5
SS WASHINGTON MAIL	AMERICAN	3	41.5 N	171.3 E	00	28	30	5 NM	25	992.8	7.2	13.9	4	10	28	8	26
SS SEALAND TRADE	AMERICAN	3	39.7 N	174.4 E	06	28	45	10 NM	25	999.3	7.2	15.6	8	19.5			
MV VAN CONQUEROR	LIBERIAN	3	43.6 N	168.2 E	06	28	M 35	5 NM	03	992.0	5.0	8.0					
SS ZIM TOKYO	GERMAN	3	37.3 N	179.6 W	06	29	48	5 NM	81	1001.0	11.8	16.1		10	29		16.5
MV VAN CONQUEROR	LIBERIAN	4	44.1 N	176.0 E	06	28	M 38	5 NM	03	996.0	3.0	6.0					
SS WASHINGTON MAIL	AMERICAN	4	43.3 N	178.8 W	00	27	45	5 NM	88	992.1	6.7	9.4	4	6.5	27	8	23
MV FERNSIDE	NORWEGIAN	4	34.9 N	171.6 W	06	26	42	> 25 NM	02	1009.0	17.0	16.0	4	10	28	8	16.5
SS PHIL MAIL	AMERICAN	4	53.2 N	176.9 E	00	02	35	10 NM	01	988.0	2.8	4.4	5	14.5	02	< 6	24.5
MV EASTERN BUILDER	LIBERIAN	5	41.8 N	155.2 W	12	24	M 41	5 NM	02	991.0	11.0	12.0	6	6.5	24	6	11.5
MV PACIFIC ARROW	JAPANESE	6	37.8 N	154.5 W	18	29	M 52	.5 NM		994.5	13.0		5	6.5	25	9	13
SS PRES JOHNSON	AMERICAN	6	35.0 N	159.0 W	12	28	45	5 NM	16	997.0	16.7	16.7	5	10	28	>13	24.5
MV ASHBY MARU	JAPANESE	6	35.8 N	171.6 W	00	27	M 32	.25 NM	07	996.0	17.0	17.0			25	>13	10
SS PHIL MAIL	AMERICAN	6	46.6 N	155.9 E	06	14	42	200 YD	75	992.6	0.0	2.2			16	7	10
MV CHALMETTE	LIBERIAN	6	33.3 N	174.6 W	00	27	48	2 NM		1005.3	18.2	19.0	8	19.5			
MV HONSHU MARU	JAPANESE	7	48.9 N	178.3 E	12	30	M 44	1 NM	07	980.0	3.5	4.5			29	9	13
SS PHIL MAIL	AMERICAN	7	44.8 N	152.0 E	06	27	45	10 NM	85	991.0	- 3.3	3.9	5	16.5			
MV ASIA BRIGHTNESS	LIBERIAN	7	46.6 N	140.9 W	00	18	45	1 NM	61	992.3	12.0	13.0	5	14.5			
MV EASTERN BUILDER	LIBERIAN	7	38.9 N	156.9 W	00	23	M 60	5 NM	01	1003.0	9.0	14.0			24	13	19.5
MV VAN CONQUEROR	LIBERIAN	8	45.6 N	147.2 W	12	18	M 45	2 NM	81	996.0	8.0	8.0					
MV EASTERN BUILDER	LIBERIAN	8	39.0 N	161.9 W	06	23	M 45	2 NM		1008.0	15.0	15.0	5	8	23	7	16.5
SS AVILA	AMERICAN	9	56.2 N	144.5 W	00	14	45	10 NM	02	988.8	5.6	3.9	8	19.5			
MV EASTERN BUILDER	LIBERIAN	9	39.5 N	166.0 W	00	23	M 42	2 NM	51	1004.0	15.5	15.0	5	5	24	7	13
SS HAWAIIAN QUEEN	AMERICAN	10	47.2 N	126.6 W	18	16	56	1 NM	65	1003.1	12.2	11.1	8	14.5			
MV CHALMETTE	LIBERIAN	11	34.8 N	156.6 E	06	24	M 30	5 NM	02	1005.3	21.0	18.0			24	8	13
MV HONSHU MARU	JAPANESE	12	49.1 N	137.8 W	12	30	M 47	5 NM	02	997.0	7.0	6.3			30	6	10
SS NEWARK	AMERICAN	12	51.5 N	131.5 W	18	12	45	10 NM	63	992.2	6.7	8.9	4	8	14	8	11.5
MV CHALMETTE	LIBERIAN	12	35.1 N	156.1 E	00	29	M 48	10 NM	02	1007.7	18.5	20.0			29	6	10
MV VAN FORT	LIBERIAN	13	43.8 N	152.8 W	00	19	M 47	5 NM	60	997.0	9.0	9.0					
SS WASHINGTON MAIL	AMERICAN	13	50.9 N	132.6 W	00	29	50	5 NM	02	1000.1	7.8	10.0	2	8	29	< 6	14.5
SS SEALAND COMMERCE	AMERICAN	13	34.6 N	174.7 E	12	27	48	1 NM	63	1003.5	11.1	15.6	5	8	27	8	13
SS PHILADELPHIA	AMERICAN	13	53.0 N	134.0 W	19	13	30	2 NM	61	1005.6	6.1	10.0	8	11.5			
MV ASIA BOTAN	LIBERIAN	13	35.3 N	174.2 E	06	29	M 46	1 NM		1001.0	14.0	19.0	8	10	29	12	16.5
MV ATLANTIC PHOENIX	BRITISH	13	40.5 N	176.8 E	18	34	42	2 NM	60	990.0	5.0	10.0					
SS WASHINGTON MAIL	AMERICAN	14	53.2 N	142.2 W	00	29	30	5 NM	03	978.5	7.7	8.3	4	11.5	XX		19.5
SS SEALAND COMMERCE	AMERICAN	14	34.5 N	163.6 E	18	18	45	10 NM	02	1006.4	16.7	16.7	5	10			
MV TOYOTA MARU #2	JAPANESE	14	39.8 N	176.0 W	06	28	M 42	5 NM	01	987.0	10.0	10.0	8	13	23	8	14.5
SS ARCO PRUDHOE BAY	AMERICAN	14	50.4 N	137.3 W	00	28	45	2 NM	07	994.1	5.2	6.7	7	8	24	8	28
SS PHILADELPHIA	AMERICAN	14	54.0 N	135.7 W	00	20	50	5 NM	02	982.1	7.3	10.0	7	11.5	20	6	24.5
MV ATLANTIC PHOENIX	BRITISH	14	40.6 N	178.6 E	00	01	41	1 NM	07	993.5	10.0	13.0					
MV CHALMETTE	LIBERIAN	14	34.9 N	145.2 E	12	26	34	5 NM	02	1003.0	16.5	19.7					
MV GOLDEN RAY	LIBERIAN	15	42.0 N	157.6 E	12	27	M 48	5 NM	02	978.0	5.0	9.0	8	19.5			
MV EASTERN BUILDER	LIBERIAN	15	40.0 N	160.9 E	00	27	M 38	1 NM	20	990.0	14.0	12.0			27	7	18
MV BERINGCORE	GERMAN	15	35.4 N	157.5 E	00	30	41	5 NM	25	1001.5	15.7		10	13			
MV BEISHU MARU	JAPANESE	15	47.5 N	166.6 W	06	03	M 43	200 YD	62	999.0	4.0	8.0	5	6.5	03	7	32.5
SS JAPAN MAIL	AMERICAN	15	40.6 N	146.9 E	00	31	49	5 NM	03	1001.0	2.2	3.3			31	7	32.5
SS PHIL MAIL	AMERICAN	15	38.2 N	163.1 E	12	28	42	5 NM	80	992.9	10.0	10.6	5	11.5	28	< 6	14.5
MV TOYOTA MARU #2	JAPANESE	15	39.8 N	170.0 W	00	29	M 43	5 NM	01	1002.0	10.0	12.5	8	14.5			
SS PACIFIC BEAR	AMERICAN	15	37.7 N	170.7 W	00	29	35	10 NM	16	1009.8	8.9	14.4	6	13	29	>13	26
SS SEALAND COMMERCE	AMERICAN	15	34.6 N	159.2 E	06	28	42	10 NM	16	1001.0	16.1	15.6	5	13	23	7	13
MV ASIA BOTAN	LIBERIAN	16	34.6 N	161.6 E	00	30	M 45	2 NM		1011.0	14.0	17.0	7	11.5	30	10	21
MV BERINGCORE	GERMAN	16	36.7 N	153.6 E	00	32	30	5 NM	01	1015.3	10.4	17.2	11	10.5			
MV EASTERN BUILDER	LIBERIAN	16	39.7 N	157.3 E	06	32	M 54	5 NM	79	1007.0	9.0	13.0			32	10	21
MV GOLDEN EXPLORER	LIBERIAN	16	43.8 N	171.5 W	00	14	M 45	2 NM	62	998.0	5.0	9.0	6	24.5			
SS PHIL MAIL	AMERICAN	16	38.7 N	168.1 E	00	27	49	5 NM	27	988.0	10.0	10.6	5	11.5	27	< 6	23
SS POLAR ALASKA	LIBERIAN	16	53.9 N	174.0 W	18	07	M 52	2 NM	85	988.0	2.1	2.0	14	16.5			
SS PACIFIC BEAR	AMERICAN	16	36.5 N	178.0 W	00	18	30	1 NM	81	996.6	14.4	13.9	5	13	19	12	19.5
MV VAN ENTERPRISE	LIBERIAN	16	49.4 N	176.2 E	06	04	M 44	2 NM	71	979.0	0.0	4.0	6	10	04	12	16.5
MV VAN FORT	LIBERIAN	16	42.2 N	172.0 W	06	24	M 42	5 NM	01	987.5	10.5	9.0					
MV EASTERN BUILDER	LIBERIAN	17	39.8 N	155.5 E	00	32	M 41	5 NM	60	1013.5	5.0	12.0	6	8	32	9	14.5
MV MONTIGNY	LIBERIAN	17	49.5 N	128.1 W	06	29	M 42	2 NM		1017.2	8.8	12.0	6	13	29	8	16.5
MV VAN FORT	LIBERIAN	17	40.5 N	174.6 W	00	25	M 62	2 NM	00	985.0	8.0	10.0			25	9	44
SS WASHINGTON MAIL	AMERICAN	17	53.7 N	178.2 E	00	07	30	5 NM	23	995.0	- 0.6	3.8	5	13	11	8	24.5
SS POLAR ALASKA	LIBERIAN	17	54.0 N	172.9 W	00	08	M 30	2 NM	85	985.0	1.8	2.0	12	14.5			
MV ASIA BRAVERY	LIBERIAN	18	44.5 N	134.8 W	00	20	M 42	2 NM	50	1014.0	13.0	12.0	3	6.5	20	6	13
MV CITADEL	SWEDISH	18	25.0 N	127.0 E	18	01	45	2 NM	25	1016.0	22.0	26.0	3	10	01	8	26
MV ASIA BRAVERY	LIBERIAN	19	40.8 N	144.5 W	18	20	M 43	5 NM	02	1015.8	15.5	13.0	4	8	20	6	14.5
MV VAN ENTERPRISE	LIBERIAN	19	44.2 N	131.0 E	18	10	M 48	.5 NM		998.0	2.0	2.0	6	8	10	10	13
MV VAN FORT	LIBERIAN	19	40.6 N	170.3 E	18	17	M 35	5 NM	63	993.5	7.0	11.0					
MV MONTIGNY	LIBERIAN	20	51.3 N	146.6 W	18	27	M 45	10 NM	25	1003.5	3.0	10.0	9	19.5			
SS WALTER RICE	AMERICAN	20	35.2 N	122.1 W	12	30	45	10 NM	02	1022.8	13.3	13.7	6	6.5	30	9	10
MV VAN FORT	LIBERIAN	20	40.4 N	167.3 E	12	26	M 30	5 NM	02	992.5	6.5	12.0					
MV ASIA ZEBRA	LIBERIAN	21	48.0 N	126.9 W	00	21	M 41	5 NM	50	1000.0	12.0	10.0	11	16.5			
MV VAN ENTERPRISE	LIBERIAN	21	41.7 N	142.7 E	00	28	M 41	10 NM	03	1013.0	4.0	3.0			28	< 6	10
MV VAN FORT	LIBERIAN	21	40.4 N	165.9 E	00	27	M 45	10 NM	00	997.5	6.0	13.0					
SS MOBIL OIL	AMERICAN	22	50.8 N	131.4 W	00	27	M 45	5 NM	82	1011.9	8.0	9.5	5	8	28	6	24.5
SS WALTER RICE	AMERICAN	22	41.4 N	125.0 W	00	29	45	5 NM	18	1024.2	16.0	10.0	6	10	29	8	14.5

Vessel	Nationality	Date	Position of Ship Lat. deg.	Long. deg.	Time GMT	Wind Dir. 10°	Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Sea	Sea Waves+ Period sec.	Height ft.	Swell Waves Dir. 10°	Period sec.*	Height ft.
NORTH PACIFIC OCEAN		DEC.															
SS CHEVRON HAWAII	AMERICAN	23	55.1 N	142.9 W	18	24	55	2 NM		988.1	5.6	4.4	6	10	24	10	24.5
SS CHEVRON HAWAII	AMERICAN	24	54.8 N	142.5 W	00	25	M 58	5 NM	07	998.2	6.1	3.9	5	19.5	24	11	41
SS MOBIL OIL	AMERICAN	24	57.5 N	147.7 W	00	27	M 60	2 NM	07	979.3	5.0	5.5			27	9	19.5
SS CHEVRON HAWAII	AMERICAN	25	51.6 N	136.8 W	00	31	M 56	10 NM	01	1009.9	6.7	5.6	6	24.5	29	9	41
MV MIDAS RHEIN	LIBERIAN	25	39.6 N	168.5 E	18	18	M 45	> 25 NM	02	1010.5	8.8	9.0	6	11.5	12	6	19.5
MV HONSHU MARU	JAPANESE	26	48.8 N	177.2 E	06	14	M 45	1 NM	74	1001.5	1.5	4.0	6	8	14	8	11.5
MV MAMMOTH FIR	LIBERIAN	26	44.3 N	149.0 E	00	27	M 57	2 NM	23	993.0	4.0	5.5	11	24.5			
SS AMER LEGION	AMERICAN	26	20.8 N	179.2 W	06	03	50	2 NM		1019.3	23.3	26.1	6	16.5	03	>13	29.5
SS CHEVRON HAWAII	AMERICAN	27	41.2 N	125.7 W	06	23	45	1 NM	21	1000.1	12.8	10.0	5	11.5	23	10	24.5
MV HONSHU MARU	JAPANESE	28	47.6 N	164.8 E	12	25	M 51	.5 NM	07	988.0	- 1.0	2.5	8	26	27	8	29.5
MV MONTIGNY	LIBERIAN	28	49.1 N	161.8 E	06	28	M 44	.25 NM	45	985.0	0.5	6.0	8	19.5			
USCGC CONFIDENCE	AMERICAN	29	54.0 N	148.0 W	06	26	M 50	2 NM	25	972.9	3.4	4.4			26	9	36
SS PHIL MAIL	AMERICAN	29	54.0 N	142.4 W	06	23	50	2 NM		979.5	3.9	5.6	6	10	23	8	19.5
SS SANTA MARIA	AMERICAN	29	56.0 N	139.1 W	18	32	47	5 NM	60	985.4	4.4	7.8	7	13	29	10	26
SS PHIL MAIL	AMERICAN	30	54.0 N	149.0 W	06	19	45	2 NM	81	995.0	5.5	3.8	6	10	20	7	16.5
MV ASIA ZEBRA	LIBERIAN	31	35.6 N	173.6 E	01	(9	M 55	.25 NM	63	1000.0	14.0	16.0	11	21			
SS PHILADELPHIA	AMERICAN	31	52.2 N	133.0 W	06	16	55	2 NM		1009.8	7.8	8.4			16		19.5
SS MOBILE	AMERICAN	31	54.6 N	136.5 W	12	24	50	10 NM	02	996.5	8.3	8.3			26	10	19.5
SS IDAHO STANDARD	AMERICAN	31	53.1 N	138.7 W	12	28	63	5 NM	01	997.8	5.0	7.2	5	14.5	17	7	21

+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind
(G) Typhoon Gloria

NOTE: The observations are selected from those with winds ≥ 35 kt or waves ≥ 25 ft from May through August (≥ 41 kt or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest wind speed was selected.

(Continued from page 173.)

Meanwhile, Kit was coming to life in the Philippine Sea (11°N, 132°E). Late on the 19th, she reached tropical storm strength, running westward. Kit's winds climbed to 40 kn before she tore through the central Philippines. This was attested to by the DPAE, which encountered 40-kn winds, at 0000 on the 20th. The Islands were enough to disrupt her circulation, and, by the 21st, she was an unorganized cloud mass. However, on the 22d at 1200, the JAPAN POPLAR encountered northerly 40-kn winds 100 mi north of the storm's center. Kit had reorganized near 9°N, 111°E. Winds near her center were estimated at 50 kn as she moved westward. On the 24th, Kit once again weakened, this time near the entrance to the Gulf of Siam.

Casualties--The 11,151-ton SACRAMENTO VENTURE reported being dead in the water 1,200 mi east of Yokohama. Her holds were flooded and leaking as a result of heavy weather on the 4th. The Korean SU-SONG (9,871 tons) reported heavy weather damage on arrival at Yokohama on the 10th. The 9,412-ton Panamanian BELLATRIX arrived Honolulu, on the 15th, with a deck buckled due to heavy weather. The Japanese freighter KIHO MARU (2,636 tons) sank in rough water about 1,000 mi south of Tokyo on the 16th. Only one crew member was rescued; 2 bodies were recovered, and 20 were missing. On the 21st, the Panamanian freighter BENEFINA (6,043 tons) sank in heavy seas near 19.2°N, 120.4°E. Of the crew, 18 were rescued and 21 missing.

Rough Log, North Atlantic Weather

February and March 1975

ROUGH LOG, FEBRUARY 1975--The storm tracks were near normal this month in number and location. The major track that affected mariners was off the U.S. east coast, over the Grand Banks, and toward the Denmark Strait. This month there was more of a curve eastward prior to turning northward than climatology indicates. This also tended to divert the storms along the east coast of Greenland, rather than splitting up both coasts. There were several storms in the Mediterranean Sea, as would be expected.

The Icelandic Low was located at 58°N, 40°W, within a few miles of its climatic position (60°N, 40°W), but was much more intense, 987 mb versus 1004.3 mb. The mid-Atlantic High was normally located, but about 4 mb higher in pressure. The pressure gradient between the major pressure centers was more than double what it normally is, 37 mb instead of 16 mb (fig. 40). This would indicate that the average winds were much stronger than usual, and the storms more intense. The high-pressure center over central Europe also had a much higher pressure. It was 1029

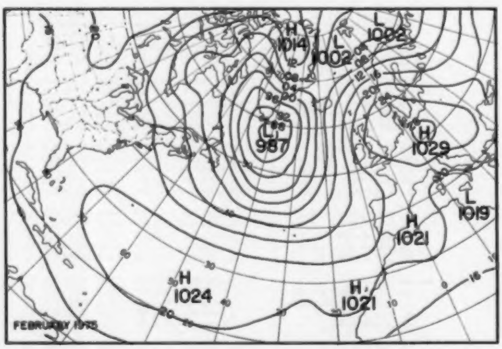


Figure 40.--The mean-pressure pattern for February is much more intense than climatology.

mb, compared to a 1018.7-mb climatological value.

These vast pressure differences were of course reflected in the anomalies. A minus 17-mb anomaly was centered near 57°N, 40°W. A positive 13-mb center was near the southern tip of Norway. The central ocean reflected a large area with a small positive value--2 to 3 mb.

The upper-air height centers were near their climatological positions, but, as with the surface, were more intense with a much tighter gradient. The slight ridge that is normally on a north-south line through the Bay of Biscay was an omega block with a closed center over the Netherlands.

Extratropical Cyclones--Monster of the Month--Giant oaks grow from small acorns. So it was with this storm, which started as a minor perturbation on a front over east Texas. The frontal wave moved eastward at about 50 kn. On the 4th, it turned northeastward. It was not until 1200 on the 4th that gale-force winds were observed. The storm's forward speed had slowed to 35 kn, and it had acquired a large circulation.

At 0000 on the 5th, the 944-mb center was at 49°N, 39°W, with a small subcenter of 976 mb near 42°N, 43°W. The C. P. DISCOVERER was less than 60 mi east of the center, with 60-kn winds and 39-ft swells. The LONG HOPE south of the center, and another ship west of the center, had 60-kn winds with seas up to 33 ft. West and southwest of the subcenter, the winds were even stronger. The EUROFREIGHTER (42.4°N, 45.6°W) was ravaged by 75-kn winds. Not far away, the AVEDRECHT, near 41.5°N, 45°W, had 65-kn winds. Neither reported wave heights, the seas probably being so rough and the spray so heavy, it was almost impossible to tell where the boundary was. The sea analysis showed a large area roughly bounded by 35° to 60°N, and 20° to 50°W, as having waves over 20 ft. A comma-shaped area about 5° wide, north and west of the center, indicated waves of at least 36 ft.

At 1200 (fig. 41), the ERLANGEN was added to the 60-kn club. The TEXACO BRUSSELS, ROSINA TOPIC, and the MONT LOUIS were in the 50-kn bracket. At 0000 on the 6th, the DIMITROVO and IBEFJORD, on opposite sides of the LOW, now near 56°N, 39°W, had 50- and 55-kn winds. The IBEFJORD (53°N, 43°W) reported 39-ft seas from 320°, and 36-ft swells from 280°. Kap Farvel reported three-star snow and measured 65-kn winds. It was probably in this storm that the Liberian-registered MYTHIC reportedly received heavy-weather damage to her hull.

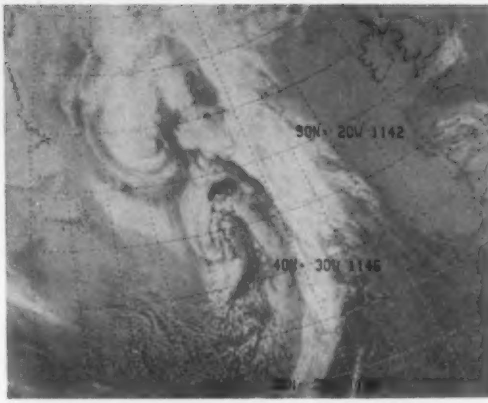


Figure 41.--The complicated cloud pattern indicates the complexity and severity of the storm. Large areas of cyclone vorticity are indicated by the comma-shaped cloud patterns.

The LOW was quickly using up its energy and was filling, almost explosively. By 1200 on the 7th, its pressure was only 995 mb, just south of Kap Farvel. Far to the south, the NEPTUN, at 37°N, 34°W, reported 60-kn winds as another LOW formed northeast of her position. Gales were still blowing over much of the area. The LOW wandered in the vicinity of Kap Farvel through the 8th, when it moved up the west coast of Greenland to finally dissipate on the 10th.

This storm originated off Cape Hatteras on the 7th. It moved along the Gulf Stream to near 43°N, 45°W, at 1200 on the 8th. Gales were now being reported south of the center. The gradient was weak to the north, with the pressure pattern broken up by three small centers strung out along 48°N.

Twenty-four hours later, the storm was 968 mb near 50°N, 38°W, and was now the main circulation across the shipping lanes. By 0000 on the 10th, the ATLANTIC CONVEYOR, at 48°N, 43°W, was whipped by 60-kn winds, while the LOIRE was mauled by 70-kn winds south of the center near 48°N, 37°W. A ship 180 mi farther south reported 50-kn winds with 30-ft seas (fig. 42).

Figure 42.--As this satellite image shows, the cloud pattern is not always a good indicator of windspeed. The reported winds were nearly equal to those in the previous storm, but the cloud pattern is quite different than in figure 41.

At 1200 on the 10th, two ships whose call letters could not be identified radioed 50-kn winds and 30-ft seas. It's surprising how many ships get religion when the winds and waves get high and send in weather reports and their positions. Later in the day, the LOW's track turned southeastward as it began to fill. It again turned east-northeastward and passed over England, on the 12th, to dissipate near Leningrad on the 14th. This was one of two LOWs that managed to track from continent to continent intact this month.

The central Appalachian Mountains were a strange place to develop a storm, but that is where this one was first identified. It developed very rapidly as it moved off and up the East Coast. At 1200 on the 10th, it was 986 mb, centered south of Newfoundland, with gales. By 1200 on the 11th, the pressure had plunged to 954 mb. The OTTO GROTEWOHL, northeast of Notre Dame Bay, suffered 55-kn winds. The GODAFOSS and KHIBINSKIE GORY, south of the center, fought 50-kn storms. The MANDARINCORE, in the southeast quadrant, had only 45-kn gales, but fought 36-ft seas and 41-ft swells. As the storm moved over the Labrador Sea, a ship battled 60-kn winds and 31-ft waves near 50°N, 45°W.

The center turned westward in the Labrador Sea and was stationary for about 36 hr. For over 24 hr, Kap Farvel was blasted by 55- to 65-kn winds. The storm disappeared on the 14th.

A trough that extended over eastern Newfoundland from a LOW in the Denmark Strait was the birthplace of this storm, late on the 17th. In less than 12 hr, it developed into a well-organized circulation. At 0000 on the 18th, the DART AMERICA was near 48°N, 37.5°W, about 250 mi southeast of the 978-mb center, with 60-kn winds, 20-ft seas, and 30-ft swells. The center raced northward, leaving gales and high seas in its wake. Forty-five- and 50-kn winds, with waves up to 30 ft, were reported as far as 600 mi south of the center.

At 0000 on the 19th, the two Ocean Weather Stations, "I" and "J," had 50- and 40-kn winds from the south, respectively. INDIA had 28-ft seas, and JULIETT had 26-ft swells. On the 19th, the storm stalled near the Greenland coast and gradually filled until absorbed by the next LOW.

The Grand Banks produced this LOW early on the 20th. Within a few hours, it was developing gales as it moved northeastward. At 1200 on the 21st, the ALSTER EXPRESS was near 51°N, 41°W, when the 960-mb center was near 53°N, 35°W, and had 60-kn starboard winds. About 450 to 500 mi to the south, 40- to 50-kn winds were blowing with waves up to 25 ft, as reported by the ATLANTIC CHAMPAGNE, LAURENTIAN FOREST, and the NORSE VIKING. The LOW raced past the eastern tip of Iceland, on the 23d, and joined another LOW to the north.

By the 21st, the upper-air support for the development of surface circulations had shifted southwestward to the familiar Cape Hatteras area. The frontal wave moved eastward and was past midocean before any significant development occurred. By 1200 on the 23d, the 964-mb storm had made its way to near 50°N, 33°W (fig. 43). The MANCHESTER ZEAL was near 40.5°N, 42°W, and struggled with 60-kn winds. The LAURENTIAN FOREST had sailed out of one storm into another; this time the winds were 55 kn. The LEVERKUSEN had 50-kn winds. The GREAT REPUBLIC, about 300 mi directly south of the center, had mild 35-kn gales, but the seas were 15 ft, and the swells 30 ft. The AKADEMIK RYKACHYEV, within 1° latitude of the center, was battered for awhile by vicious cross-waves of 26 ft from 220°, and 33 ft from 120°.

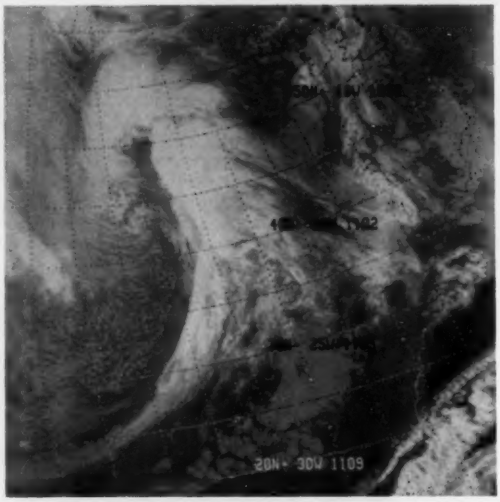


Figure 43.--Although similar features can be identified in the cloud pattern of each storm, the total cloud pattern depends on too many variables to be identical.

The storm's path was toward Kap Farvel, and the pressure was 948 mb, at 1200 on the 24th. The closest ship report was 50 kn, just off the western Iceland coast. High swells were the major factor to the south, where the closest report was about 600 mi from the center. As the center reached the southeast coast of Greenland, it deteriorated rapidly. This was assisted by a new LOW near 45°N.

This was the LOW that assisted in the demise of the one above. It developed in the Gulf of St. Lawrence, on the 23d, and moved southeastward and eastward around the circulation of the storm described above. Gales were reported around the storm, on the 24th and 25th. At 1200 on the 25th, the 964-mb center was near 47°N, 31°W. A ship reported 33-ft swells about 200 mi south of the center. At this time, the storm became stationary. The ATLANTIC COGNAC, near 42°N, 32°W, was battered by 50-kn winds and 36-ft seas. A ship east of the center, near 46°N, 24°W, was sailing with 40-kn winds on her stern, 13-ft seas, and 33-ft swells.

As the cyclone continued to spin near 45°N, 30°W, at 1200 on the 26th (fig. 44), the ATLANTIC COGNAC turned northwestward into the 65-kn maelstrom, which was driving 49-ft seas. The C. V. STAGHOUND and EXPORT LEADER were farther to the west and south-

Figure 44.--This storm has yet another cloud pattern.

west with only 40- and 50-kn winds, with swells to 25 ft. At 0000 on the 27th, Ocean Weather Station "K" reported 45-kn winds, but the seas were a keel-breaking 39 ft. Twelve hours later, the HEMIMACTRA, about 150 mi north of Kilo, reported 33-ft swells.

The LOW was now moving toward the southeast, and the pressure had risen to 992 mb. At 1200 on the 28th, it could no longer be analyzed from the ship reports.

This storm had only a minor effect on coastal shipping, but could have been quite dangerous to any shipping on the Great Lakes. A few ships were still operating on the Lakes this month. The storm originated in Louisiana, on the 23d, and moved northward. Over the Ohio River, it curved northwestward for 12 hr before continuing northward through Wisconsin. Late on the 24th, a thunderstorm with 87-kn winds hit Olean, in western New York.

After the storm center crossed Lake Superior, gale warnings were hoisted for the Lakes. On the 26th, the storm center was east of James Bay at 972 mb. Storm warnings were now up for the Lakes. Westerly winds with gusts over 50 kn were producing waves up to 14 ft high, and beach erosion and flooding were occurring on the eastern ends of Lakes Ontario and Erie. The Coast Guard Station at Erie, Pa., and also Rochester, N.Y., reported gusts over 50 kn. Waves of 6 to 12 ft were reported on the eastern shore of Lake Michigan. It was not until the 27th that the warnings were lowered. At this time, the storm's center was over the eastern shore of Hudson Bay and again turning westward, which meant its demise.

Ships on the Mediterranean Sea may have viewed the dense clouds of smoke, ashes, and sand from an eruption of Mt. Etna, on Sicily, which began on the night of the 23d and continued for several days.

Casualties--In the Gulf of Mexico, off Galveston Island, the 9,043-ton Finnish freighter MALTESHOLM (fig. 45) and the 19,724-ton Panamanian freighter

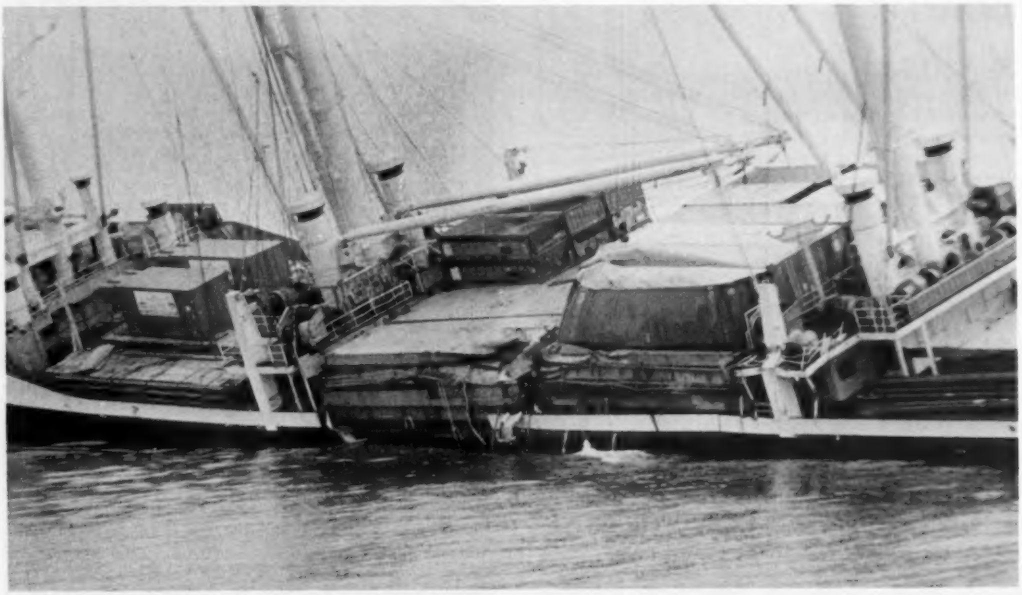


Figure 45.--The damage to the port side of the MALTESHOLM is plainly visible. For awhile, the pumps were reportedly unable to keep pace with the water inflow. U.S. Coast Guard Photo.

MARITIME UNITY collided in dense fog on the 2d. The Canadian CHESLEY A. CROSBIE became immobilized in ice, on the 3d, after having engine problems. A sister ship towed her to Seven Islands, escorted by the icebreaker SIR JOHN A. MACDONALD. The Cypriot tanker ATHENIAN STAR (11,879 tons) sustained a crack in her hull in 40-ft seas, while on a voyage from Rotterdam to the United States.

The crew of the Greek tanker IOANNA (9,918 tons) was taken off the vessel due to taking water in heavy weather, while aground 20 mi off Rijeka, Yugoslavia. The barge HANNAH 2901 broke away from the tug JAMES A. HANNAH during high winds, at Milwaukee on the 23d.

ROUGH LOG, MARCH 1975 -- There were vast differences in the monthly mean weather patterns of February and March. The February pressure centers were much more intense (fig. 40) than the climatological average and the March mean (fig. 46). This did not necessarily apply, though, to an individual storm that the mariner may have encountered. Last month, high pressure over Europe diverted storms northward, while this month, the English Channel and Iberian Peninsula were favorite paths.

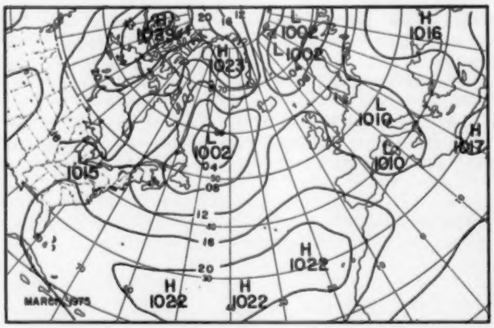


Figure 46. -- Major differences are apparent between the March mean-pressure pattern and that of February.

Cyclone tracks over eastern North America and off the East Coast were relatively normal in number and location. According to climatology, they converge near Newfoundland and then branch toward either Kap Farvel or Iceland. This month the track toward Iceland was diverted east- and southeastward into Europe.

The major difference in the mean pressure from climatology was a 1010-mb Low over central Europe and the Ligurian Sea, rather than a 1017.1-mb High. The High center was many miles to the southeast over eastern Libya. The 1002-mb Icelandic Low was near 57°N, 48°W, and about 10° longitude west of its 1005.3-mb climatic position. A ridge from the 1022-mb Azores High extended northward west of Europe.

There were four significant anomaly centers. A negative 5-mb center was located between Labrador and Kap Farvel. A negative 7-mb center was over northern Italy. The ridge produced a positive 5-mb center west of Ireland and south of Iceland, and a positive 4-mb center was near the Canary Islands.

The upper-air pattern was near normal except for more intense ridging off western Europe and a sharp trough over central Europe. The Low centered near Kap York, Greenland, was deeper than normal, resulting in a steeper north-south gradient.

Extratropical Cyclones--This storm formed southeast of the Grand Banks, early on the 1st, in a trough left behind by a previous LOW. It developed rapidly in the wake of another LOW about 24 hr ahead. At 1200 on the 1st, the EVELYN BOLTEN was headed northeastward with 50-kn winds on her port side. Between the two LOWs, the ARES and ORCOMA both contended with 45-kn gales, with the former reporting 16-ft seas and 25-ft swells. Twelve hours later, the BOLTEN was still battling 50-kn winds. By midday on the 2d, the LOW was 964 mb near 50°N, 24°W. The ATLANTIC CHAMPAGNE was headed southwestward near 47°N, 30°W, and being hammered by 60-kn northwesterly winds driving 39-ft seas. To the east, the DART AMERICA (47°N, 25°W) was sailing with 50-kn westerly winds on her stern and being rocked by 13-ft seas and 23-ft swells. The BUNTENTOR and AMERICAN ACCORD, both along 45°N, fought 45-kn gales and seas up to 33 ft.

At 0000 on the 3d, the DART AMERICA (47°N, 20°W) and the VAUCLUSE (47°N, 18°W) both battled 60-kn westerly winds. For that speed winds, the waves were a relatively mild 20 ft. As the storm approached Lands End, on the 4th, it was weakening, but, at 0000, there were reports of 23- and 30-ft swells west of the Bay of Biscay. The Greek motorvessel ARPA SUN arrived at Cork, on the 5th, with heavy-weather damage sustained on the 4th (fig. 47), during force 10 winds and 30- to 35-ft waves. On the 5th, the LOW had deteriorated to a trough moving into Scandinavia.

Figure 47. -- The storm has moved over the English Channel, at this time on the 4th.

A large storm that had developed off Norfolk, on the 2d, was north of Newfoundland on the 4th. A small circulation developed in the col area between that storm and the one previously described. As this new LOW moved over Iceland, late on the 5th, another LOW developed near 56°N, 26°W. By 0000 of the 6th, it was becoming the primary cyclone as the older ones on both sides weakened. At 1200, the 958-mb LOW was near 60°N, 18°W, and Ocean Weather Vessel "I" measured 60-kn storm winds from the west. The ship was also

being tossed by 26-ft seas and 20-ft swells 30° off the wind. Twelve hours later, the winds decreased to 35 kn, but the seas were still 23 ft and "J" was now measuring 23-ft swells. As the storm moved into the Norwegian Sea, it was slowly moving northeastward. Far to the south, between 45° and 50°N, and near 35°W, ships were reporting winds to 45 kn, as a minor trough moved through the area.

At 0000 on the 8th, a LOW had formed in the trough and was moving toward Brest. At 1200 (fig. 48), the SYLVO was near 46°N, 13°W, with 60-kn winds. Nearby, Ocean Weather Station "K" was suffering 45-kn winds and seas of 43 ft. Farther west (44°N, 22.5°W), the SEA-LAND PRODUCER had 40-kn winds and 25-ft swells. Both storms moved out of the area of interest on the 10th.

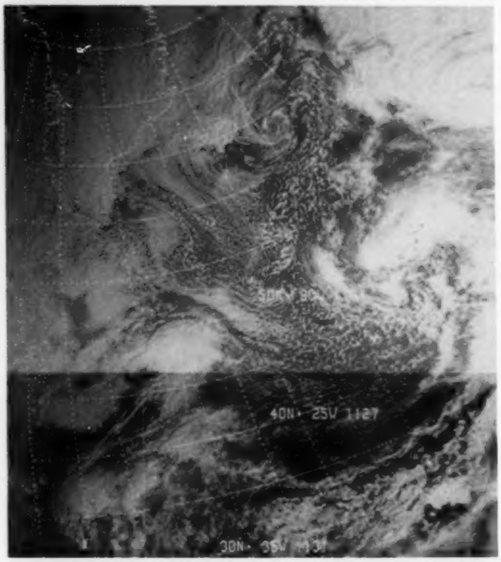


Figure 48.--There are multiple circulation centers on this satellite image strip: the two of concern here, east of Iceland and near Brest; and two others near 50°N, 35°W, and 35°N, 50°W.

A cyclone that developed on the Gulf Coast, on the 13th, was over the mountains of West Virginia, late on the 14th. At that time, another LOW developed off Wallops Island, Va. Almost immediately, there were gales blowing south and east of Cape Cod. The storm moved northeastward and was near Sable Island, at 0000 on the 16th, with a pressure of 994 mb. Gale winds were blowing in all quadrants. The VERCONELLA was plotted near 40°N, 58°W, with swell code 43 (71 ft). Other ships in the area were reporting swell code 12 (20 ft), so the code possibly should have been 13.

Gales of up to 45 kn and waves up to 28 ft continued to be reported south of the storm center as it moved east of Newfoundland. At 1200 on the 17th, the C. P. TRADER was 400 mi south of the 976-mb center with 45-kn winds. Later, at 0000 on the 18th, the AVON FOREST (46°N, 38°W) was washed by 50-kn wind-driven rain and battered by 33-ft swells. Twelve hours later, the MONT LOUIS was tossed by 30-ft swells near 49°N, 42.5°W. The LOW was now tracking northward and dissipating as the next storm approached from the south.

This was a good example of the almost explosive development of a storm over or near Cape Hatteras. At 0000 on the 17th, there were indications of a frontal wave off South Carolina. At 0600, there was a center over Pamlico Bay, and at 1200, a well-developed circulation at 36°N, 74°W. By 0000 on the 18th, the 1000-mb LOW was near 36°N, 67°W, and Ocean Weather Station "H" measured 40-kn winds and 20-ft seas.

The storm was moving between the Azores High and a HIGH moving over New England from Canada. This gave the storm an oval shape. The INVERNESS was north of the center, at 0000 on the 19th (40°N, 44°W), with a 40-kn nor'easter, 25-ft seas, and 30-ft swells. In the next 12 hr, the gradient tightened on the western side of the LOW, as it was squeezed between the HIGHs. The NORSE PILOT (35°N, 47°W) was only a few miles from the 994-mb center and fighting 60-kn winds. Thirty-foot swells and 25-ft seas were still being observed north of the storm. At 0000 of the 20th, the VICTORIA CITY radioed 55-kn winds in the same position relative to the center as was the NORSE PILOT earlier, and reported 33-ft waves.

Between 0000 and 1200 on the 21st, the ZARIA and the 984-mb LOW crossed paths in the vicinity of 38°N, 36°W. Her wind shifted from southerly to northeasterly, with seas and swells between 20 and 26 ft. On the 22d, the LOW was being pushed and pulled toward the northwest as the Canadian HIGH moved south of it, and a LOW was moving eastward south of Newfoundland.

Another East Coast storm! It was causing grief to shipping off the coast as the center passed over the Nation's Capitol, late on the 19th. At 0000 on the 20th, the CARBIDE TEXAS CITY was east of the center, near 38°N, 73°W, with 45-kn southeasterly winds, and Ocean Weather Station "H" measured 45 kn also, but added 26-ft seas. The TRANSHAWAII, off Cape Hatteras (33.6°N, 74°W), was sailing southeastward with 40-kn southwesterly gales, 33-ft seas, and 49-ft swells from the southeast (fig. 49).

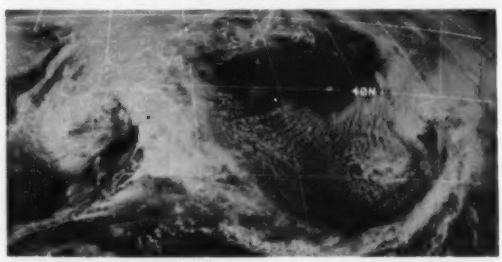


Figure 49.--The large storm influences the eastern United States and many miles to sea off the East Coast. The continuity of weather is apparent in the cloud band that stretches eastward to another cyclone in midocean.

As the storm moved over Long Island at 1200 on the 20th, HOTEL measured a piddling 10-kn wind and 3-ft seas, but the swells were 26 ft out of the south. For an East Coast storm, this one was moving northeastward at a leisurely pace. It was 988 mb over the Bay of Fundy, at 1200 on the 21st. An Estonian ship was blown by 55-kn storm winds south of Nantucket Island. The winds had picked up to 35 kn at HOTEL, but the waves had held at 25 ft. On the 22d, the HAHNENTOR, at 36°N, 61°W, was racing 33-ft swells. She wasn't the only one fighting high seas; the SULTANA, at 39°N, 59°W, at 1200, was plowing into 40-kn winds with 30-ft waves.

This was the last of the severe conditions that this LOW was reported to have contributed to mariners. It continued on an erratic track toward the English Channel, which it entered on the 27th.

Casualties--The Dutch ATLANTIC CROWN (15,469 tons), Baltimore for Havre, struck an iceberg, on the 19th, while approximately 350 mi southeast of St. John's, with damage to the stem and a crack in the forepeak. The IRISH CEDAR (10,477 tons) reported leaking of the number 1 hold due to ice damage off Anticosti Island.

Rough Log, North Pacific Weather

February and March 1975

ROUGH LOG, FEBRUARY 1975--This was probably as normal a month, when compared to the climatological mean, as is possible. The storm tracks followed the mean paths from Hokkaido and south of Kyushu toward the Rat Islands, from there south of the Aleutians into the Gulf of Alaska, almost as if they had been traced. The same applied to the tracks from the northeast central ocean into the Gulf of Alaska and Vancouver Island.

The 1000-mb Aleutian Low was almost identically located with its 1000.3-mb climatological counterpart. The most significant difference from climatology was an extension of lower pressure into the Gulf of Alaska. The 1004-mb isobar extended to near 140°W in the Gulf of Alaska, which is normally the boundary of the 1012-mb isobar. The 1016-mb isobar normally paralleled the Coast Mountains of British Columbia, with a resultant tight pressure gradient along that coast. The 1021-mb Pacific High was about 400 mi east of its 1020.8-mb climatic location. The pressure of the ridge that extends across the ocean along approximately 25°N was generally higher than normal.

The anomalies were not large. The largest both in area and depth was a negative 8-mb centered over the Gulf of Alaska and northeastern ocean. There was a negative 2-mb center over the western Sea of Okhotsk that was completely surrounded by positive values. This was the reflection of three storms that curved northwestward into the area. There was a positive 4-mb area in the central ocean near 30°N, 175°W, and a positive 3-mb area off Baja California.

The upper-air pattern was near normal with a couple of exceptions. A minor Low at 700 mb over Cape Romanzof reflected the lower sea-level pressure over the Gulf of Alaska. It also induced a short-wave trough off the North American coast, accenting the ridge over the Rocky Mountains. The height of the 700-mb surface over the tropical ocean was higher than the mean, resulting in an overall tighter gradient.

There were no tropical cyclones this month.

Extratropical Cyclones--Small frontal waves had been occurring for several days along an east-west front over the East China Sea. On the 4th, one of these was unstable and continued to develop while south of Honshu, bringing precipitation to most of Japan. As it moved over the Kuroshio Current, it continued to deepen to 976 mb, at 1200 on the 5th. The TOR FOREST was slightly south of the cold front, at 32°N, 156°E, with 50-kn southerly winds. Another unidentified ship reported 50-kn northwesterly winds at 35°N, 147°E. At 0000 on the 6th, the EASTERN MARINER, near 33°N, 157°E, was blasted by 60-kn winds off her starboard bow, and driving 25-ft swells (fig. 50). The SANSHIN TRADER was near the point of occlusion, at 36°N, 166°E, with 45-kn southeasterly winds, 21-ft confused seas, and 25-ft swells from the south. At 1200 on the 6th, the UHUE also reported 60-kn winds from the northwest with heavy snow, near 38°N, 162°E.

The storm was now tracking northward with a central pressure of 965 mb. At 0000 on the 7th, the MARQUIS, at 34°N, 171°E, radioed 45-kn winds, but she was being battered by 25-ft seas and 33-ft swells, 30° off the seas. As the storm approached the Rat Islands on the 8th, it was weakening and was absorbed by another LOW approaching from the southwest on the 9th.

This frontal wave was first indicated on the 0000 anal-

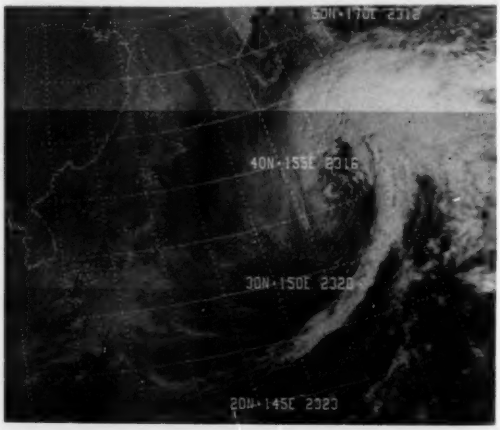


Figure 50.--At 2316 on the 5th, the center of the circulation appears to be near 37°N, 160°E.

ysis of the 11th, by the reports from three widely separated ships. By 1200, it was a 998-mb LOW, but the circulation was not well organized. Twenty-four hours later, it was a well-organized 979-mb storm. The ALASKA MARU reported 40-kn easterly winds in the northeast quadrant. The storm was moving northward into the Bering Sea. The PAPYRUS MARU found 40-kn gales and 23-ft seas near 50°N, 179°E.

At 1200 on the 13th, the JUNEAU MARU, near 51°N, 170°E, was pounded by 60-kn westerly winds (fig. 51). The Near Islands measured 50-kn west-southwesterly winds. The LOW had decreased in size, but not intensity, as it crossed into the Bering Sea. This was partially due to another storm to the south. On the 14th, the circulation was completely absorbed.

Figure 51.--The more powerful storms tended to occur in the western half of the ocean this month, as this photograph illustrates.

This storm had its beginnings, on the 12th, in a trough just off the eastern shore of northern Japan. This was also a case where the LOW developed first and then frontogenesis occurred. In the next 24 hr, the LOW traveled to 43°N, 159°E, and dropped 28 mb to a 978-mb pressure. The HIEI MARU was near 38°N, 165°E, just north of the occlusion, with 45-kn winds. Twelve hours later, at 0000 on the 14th, the AKAISHI MARU was about 100 mi southwest of the center with 60-kn winds and 23-ft swells on her stern. At 1200, the winds were still 50 kn, and the 15-ft seas and 23-ft swells still persisted. The LOW was now stalled near 48°N, 168°E, and, at 0000 on the 15th, the CHINA BEAR found the 50-kn wind band and 16-ft seas, with 23-ft swells. Forty- and 45-kn easterly winds were blowing north of the center.

The loss of forward motion was fatal to the system, as LOWs to the southeast and southwest robbed it of its strength.

This was one of the LOWs that contributed to the death of the last one. While it was at its maximum strength, this new one was starting out over the East China Sea. As the storm moved south of Japan, it gained strength, and gale-force winds were reported in the southwest quarter. At 1200 on the 15th, the 958-mb LOW was at 38°N, 157°E. The FRISKAY was near 33°N, 157.5°E, with 55-kn southwesterly winds, 20-ft seas, and 30-ft swells. The TOYAMA was west of the center with 50 kn. The JAPAN BEAR was about 100 mi east of the center with 45-kn gales and reported 26-ft seas, with 23-ft swells. At 0000 on the 16th, the PACKING radioed 60-kn storm winds and 23-ft seas at 40°N, 161°E.

At 1200, the storm was a 952-mb whirlpool (fig. 52), and shipping was giving it a wide berth, or so the reports indicated. The HONSHU MARU was near 49°N, 178°W, with 30-ft swells, and the PHEMIUS, on the opposite side of the LOW, reported 25-ft seas and swells.

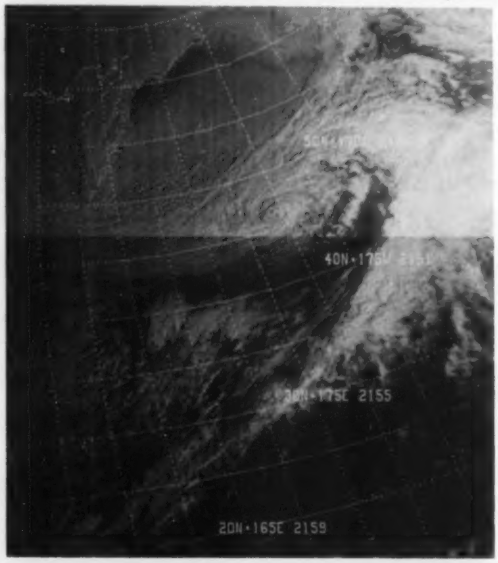


Figure 52.--The LOW is centered on the dateline, near 47°N, late on the 16th. The fronts and major cloud systems are far to the east of the center.

This system, along with a HIGH off the California coast, was now the primary circulation over the northern ocean. Two small LOWs flanked this primary one. At 0000 on the 17th, the ASIA MOMO was near 51°N, 165°E, in the northwest quadrant of the LOW, sailing with 55-kn winds and 20-ft waves. A ship south of the LOW, near 42°N, 177°W, was boosted along by 50-kn winds, while the ASIA BRIGHTNESS, near 42°N, 173°W, was plowing into 45-kn gales, 20-ft seas, and 25-ft swells. At 1200, there were no ships plotted south of the center within 700 mi of the LOW.

The cyclone had continued its eastward track while slowly filling, and the flanking LOW to the east had dawdled into the Gulf of Alaska. On the 18th, that system took over the circulation and moved into the Yukon.

This cyclone was born near Nagoya, late on the 20th.

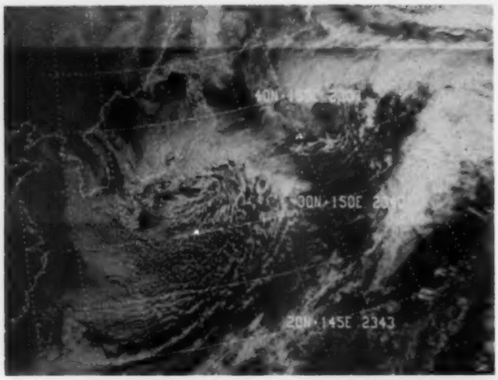


Figure 53.--The storm was over Honshu, at this time on the 20th. It was already the 21st, local time, and the SHIRETOKO and DONA PACITA were in trouble.

It matured to gale strength quickly, as the MITSUI MARU found 40-kn gales, with 20-ft waves, at 31°N, 137°E. Rain, snow, and thundershowers were occurring over the Japanese Islands. At 1200 on the 21st, the YASUKAWA MARU was 2° longitude to the east, with 50-kn winds, 10-ft seas, and giant 33-ft swells. The strong-wind band was between 30° and 35°N. Another LOW which was preceding this one was helping to build the seas and swells.

The 7,857-ton Japanese ferry SHIRETOKO MARU departed Tokyo, on the 20th, for Hokkaido. On the 21st (fig. 53), it had to divert seaward into the high waves to avoid capsizing. Contact with the ferry was lost when its course took it out of range of its radiotelephone. Radio contact was reestablished on the 22d, and it arrived at Tomakomai on the 23d. There were 156 people and 129 automobiles aboard. Three trucks, carried as cargo, shifted position. Late on the 21st, the Philippine freighter DONA PACITA (fig. 54) ran aground and snapped her hull, off Onagawa Port, northern Honshu. The freighter had taken refuge at the port from rough seas and took a wrong course when leaving. Twenty-seven of the 38 crewmembers either

Figure 54.--The 2,540-ton DONA PACITA lies broken, high on the rocks of the shore of northern Honshu. Giant waves are breaking over her. Wide World Photo.

swam to safety or were rescued by helicopter.

At 1200 on the 22d, the 984-mb LOW was at 37.5°N, 152°E. The COSMOS FOMALHAUT, HOHKOKUSAN MARU, and KUROBE MARU reported 40- to 50-kn winds, 16- to 23-ft seas, and all 26-ft swells. Twelve hours later, the SEA-LAND COMMERCE, at 33°N, 154°E, was headed into 55-kn winds and 20-ft waves, while the TOYOTA MARU No. 10 was returning to home port into 50-kn winds, 25-ft seas, and 33-ft swells. At 1200 on the 23d, the HISASHIMA MARU found the 50-kn winds and 30-ft seas about 5° farther east. By the next map, the LOW was no longer indicated by the data as having existed.

Casualties--A severe earthquake centered at 53.3°N, 173.4°E, shook the Near Islands at 0725 February 2. Large cracks up to 16 in wide and 100 ft long occurred on Attu Island. There was no tsunami, due to the epicenter being north of the Aleutians.

The Indian freighter CHENNAI MUYARCHI sustained heavy-weather damage and flooding of Hold No. 1 on a voyage from the Columbia River to Bombay, the first part of the month. The TRANSOCEAN SHIPPER, a 9,375-ton Philippine freighter, last reported passing through a storm, on the 16th, and that she had a damaged hatch cover. She was posted as missing when she failed to arrive at New Westminster, B.C., on the 25th.

The Liberian NORDIC REGENT arrived Chiba from Vancouver, on the 25th, with hatch covers leaking due to heavy weather. Winds up to 52 kn in the Vancouver area forced two anchored freighters aground in English Bay. Both were refloated with the aid of tugs. They were the 10,071-ton EVGENIA G., which broke its anchor chains, and the 10,508-ton PANAYIA MOUTSAINA.

ROUGH LOG, MARCH 1975--Japan caught the brunt of the storm tracks this month. The vast majority of the cyclones that originated in the western Pacific affected that nation. An abnormal high-pressure center over the Sea of Okhotsk diverted the cyclones off the continent southward. These storms, plus those that formed farther south, had a more easterly component over the western ocean, and then a more northerly component over the central ocean, than the climatic mean. More storms tracked into the eastern Bering Sea, and fewer into the Gulf of Alaska, than normal. Higher-than-normal pressure over extreme northern Canada diverted the storms away from the Gulf of Alaska and farther south along the U. S. west coast.

The mean pressure of the Aleutian Low was normal --1005 mb-- but was located about 20° longitude east of its mean position. The 1017-mb high-pressure center located west of Ostrov Paramushir radically changed the orientation of the isobars in that area. The Pacific High at 1025 mb was centered near its mean position, but 3 mb higher in pressure. As previously mentioned, a 1029-mb High was centered over Banks Island, on the edge of the Beaufort Sea.

The major anomalies were positive. A plus 11-mb center was near the southern tip of the Kamchatka Peninsula, and a plus 8-mb center was over Victoria Island. A large, shallow anomaly bounded by the minus 2-mb isoline stretched eastward from south of Shikoku to about 165°E. Another large, shallow, positive anomaly area covered most of the central eastern Pacific.

As with the surface, the upper-air Low was east of its mean position and, in this case, also north, over the Anadyrskiy Gulf rather than the Sea of Okhotsk. The height of the Low center was slightly lower than the climatic mean, and the High was higher than the mean.

Extratropical Cyclones--This was an offshoot of a LOW that developed near Japan, the last of February. A double LOW center developed, on the 1st, and the new 989-mb center became the primary storm. By 1200 on the 2d, the 972-mb center was near Attu Island, with its circulation extending as far south as 30°N. Gales were blowing in all quadrants. On the 3d, the maximum wind reported was 45 kn by the VOLNA, but more serious were the 33-ft seas she was fighting, near 48°N, 175°E. There were several other reports of 20- to 25-ft seas in the area 300 to 600 mi south of the LOW. On the 4th, the center moved inland near Mys Navarin, and over the cold land it quickly decayed.

This circulation started in a col on an old washed-out front, on the 1st. It moved rapidly southeastward around an upper-air LOW centered near 45°N, 135°W. Gale-force winds were blowing in the western quarter. On the 3d, the TRANSONEIDA, near 37.5°N, 144°W, reported 40-kn northerly winds. The KASHU MARU, about 200 mi to the south, reported 26-ft swells.

At 0000 on the 4th, the central pressure of the LOW was only 1006 mb, near 37°N, 134°W, but the AUSTIN found 55-kn winds near 33.5°N, 142.5°W, and 18-ft waves. The LOW drifted toward the coast, maintaining a pressure slightly over 1000 mb. On the 5th, another LOW formed near 41°N, 144°W, and also traveled southeastward, picking up the circulation of the other LOW. The winds were generally minimal gale force. As it approached the coast, on the 7th, it turned northward and, by 1200, was 991 mb near 38°N, 128°W. The CHEVRON HAWAII was off Point Buchon, with 45-kn winds and 16-ft seas. Storm warnings were flying along the California coast, where southerly winds gusted to 60 kn (fig. 55). By the 9th, the LOW

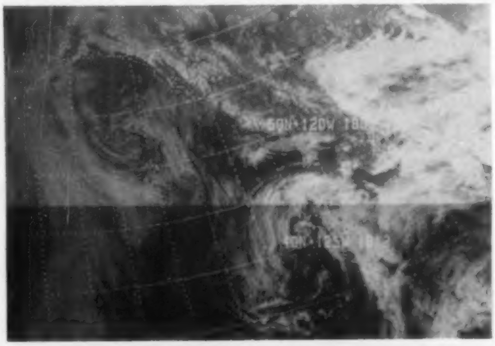


Figure 55.--The LOW is centered off the northern California coast, with thick clouds along the coast. Snow can be seen on the mountains to the north.

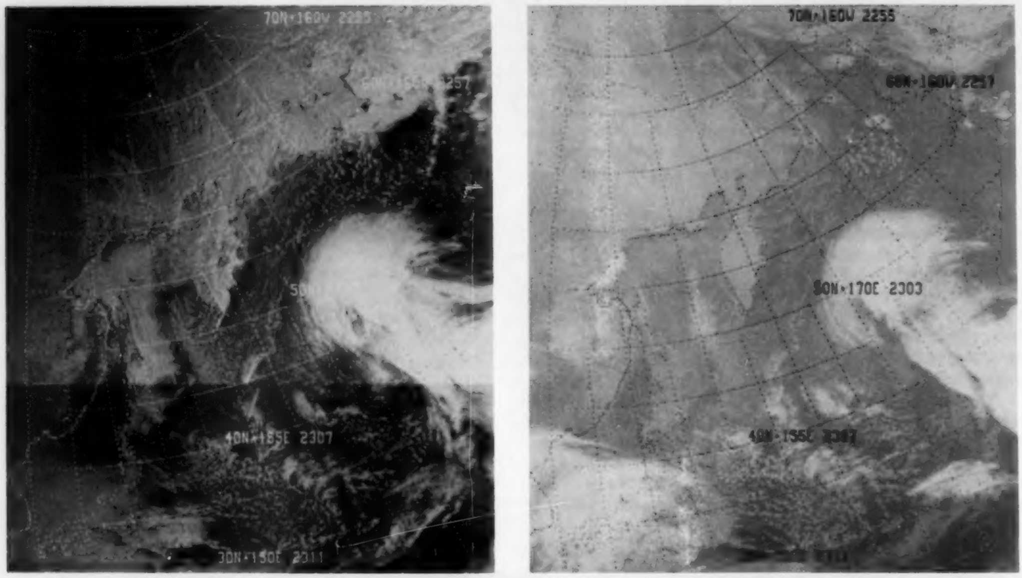


Figure 56.--This is the same orbit and area, as detected by the visual sensor--left--and infrared sensor--right, on the polar-orbiting NOAA satellite. The coldest surfaces are the brightest. The lower level clouds south and west of the storm show as a shade of gray in the infrared image, indicating their tops are warmer, and only slightly colder than the surface of the water. Snow covering eastern Siberia, and the snow-covered Sea Ice over the northern Bering Sea, appear white in the visual image. In the infrared, the snow is slightly colder than water, and Sea Ice on the Bering Sea is not obvious. The northwestern part of the visual image is dark due to lack of sunlight.

was decaying over Vancouver Island, and the winds along the coast had shifted to northwesterly.

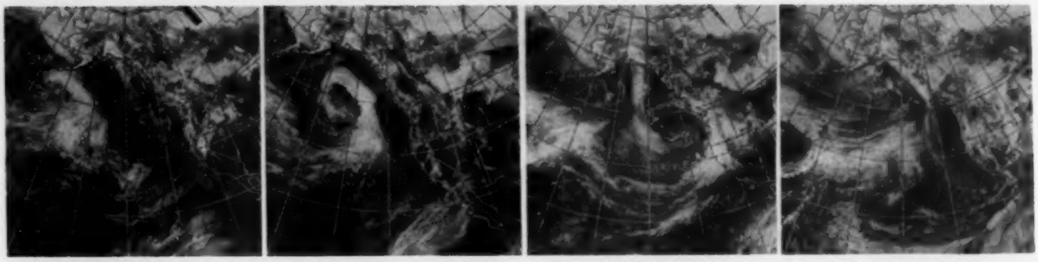
The history of this storm starts over eastern Mongolia on the 1st. It moved across the Sea of Japan on the 2d. By the 4th, it was 1002 mb near 37°N, 158°E. The PRIBOY was near 34°N, 160°E, sailing into 40-kn gales and 18-ft seas. The LOW was moving rapidly northeastward under the influence of the westerlies, prior to curving northerly on the 5th. At 0000, the 985-mb LOW was near 47°N, 172°E (fig. 56). About 100 mi to the southeast, the AMERICAN MAIL was being hammered by 60-kn starboard winds driving 21-ft seas. A ship east of the center reported 50-kn southerly winds.

As the center moved over the Near Islands, small LOWs were forming on the periphery of the circulation. These effectively weakened the circulation, decreasing the windspeeds. The major center still managed to bring 40-kn gales to the western Aleutians, and far to the southeast, ahead of the front, ships reported southerly winds to 45 kn and waves up to 26 ft. The storm moved into the Olyutorskiy Gulf, where it disappeared.

This was one of the LOWs that formed south of the previous storm. At 0000 on the 6th, it had already formed a deep pocket in the circulation. There was only one ship report near the storm at 1200, but at 0000 on the 7th, there were many. The storm was centered near 44°N, 170°W, at that time. The KANE-TOSHI MARU (38.5°N, 170°W) had 50-kn winds on her stern as she sailed eastward. Southwest of the center, at 42.5°N, 175.5°W, the ASIA BOTAN was reporting only 40-kn northwesterly winds, but the seas were reported as 46 ft.

The storm track was curving northwestward, later on the 7th, and gales were occurring over the Bering Sea. On the 8th, the DAIAN MARU was within the 50-kn isotack analysis. The ASIA BOTAN was now reporting 33-ft swells at 44°N, 169°W. As the LOW crossed the Aleutian Islands, it was absorbed by a stronger circulation.

Although this cyclone had its origin, late on the 9th, over the Korea Strait, it was not until the 14th, near Bristol Bay, that it earned a reputation. It moved eastward and then northeastward very rapidly, averaging over 40 kn for the first 48 hr. It created several instances of Beaufort force 7 and 8 winds along its path, and 15- to 20-ft seas. On the 12th, its center moved into the Bering Sea, and late on the 13th, stalled near Bristol Bay. At 0000 on the 14th, the NORBU reported 30-ft swells just north of Unmak Island. About 60 mi south of the Islands of the Four Mountains, the MIDAS ARROW was mauled by 45-kn winds, 28-ft seas, and 46-ft swells. Several other ships reported over 20-ft waves. Within a matter of hours, the LOW had disappeared, as the circulation of a LOW in the Gulf of Alaska destroyed it.



1800 March 19 | 1800 March 20 | 1800 March 21 | 1800 March 22

Figure 57.--The history of this storm at sea. These satellite images, from left to right, trace the storm for 4 days, from approximately 1800 on the 19th, to 1800 on the 22d.

This seemingly insignificant LOW was analyzed at the triple-point of a frontal occlusion on the 0000 chart of the 20th. The front was associated with a LOW that formed south of Japan on the 15th. By 1200 on the 20th, this had become the major circulation, with the pressure falling 8.4 mb at Ocean Station Vessel "P" in the previous 3 hr (fig. 57). The central pressure was 979 mb, at 50.5°N, 147°W. At 0000 on the 21st, high winds were blowing over the Gulf of Alaska and as far south as 35°N. The ASIA MONO had the worst of it, though, as she was buffeted by air moving at 80 kn. She was only reporting waves as high as 20 ft, but with that much wind, it was probably difficult to tell, because of spray, where the sea stopped and the atmosphere began. Another SHIP, which could not be identified, reported 60-kn winds, near 45°N, 146°W, with 12-ft seas, and 38-ft swells.

At 1200, Ocean Station Vessel "P" was tossed by 55-kn winds. No seas were plotted. At 0900, the winds were 60 kn, and no seas. Three hundred miles to the south, where the SEA-LAND TRADE reported only 40-kn winds, the waves were 25 ft.

The 0000 chart of the 22d indicated the PRIAM with 50-kn winds, 26-ft seas, and 38-ft swells, near 45°N, 134°W. The KATANGLI, near 48°N, 139°W, was battered by 33-ft seas and swells. Luckily, they were from the same direction, but the periods differed. Storm warnings along the Oregon and Washington coasts called for 55-kn winds, and 10- to 20-ft waves were lashing the shore. The storm went ashore late on the 22d.

This storm came out of Mongolia, closely following the track of another storm the first of the month until it reached the Kuroshio Current on the 30th. At 1200, the 982-mb center was near 39°N, 149°E. There were gales both north and south of the center. The VAN HORNE, at 35.7°N, 153.5°E, had 45-kn westerlies, with 16-ft seas, and 30-ft swells from the southwest, on the 31st. The ASIA BOTAN, near the central Kuril Islands, was battered by 55-kn winds. The storm was now tracking northward. Gales were the order of the day south of the center, from the Japanese coast to 165°E. The main concern, though, was high seas, the highest being 30 ft by the VAN HORNE, near 38°N, 157°E.

On the 1200 chart, the KINYO MARU was heading into 50-kn winds and 26-ft swells, about 250 mi south-southeast of the center. Others reported 15 to over 20 ft.

The storm was slowly tracking northeastward, east of the Kuril Islands. On April 2, another center developed north of the original one, near the Near Islands. On the 3d, the northern LOW became the major circulation center, with a sharp trough to the south. A ship near the edge of the ice field reported 40-kn winds. At 0000 on the 4th, the Siberian station of Anadyr measured 60-kn easterly winds. Later that day, the center moved over the cold land and disintegrated.

Casualties--The Japanese motorvessel TRANSPACIFIC TRADER, Astoria for Japan, diverted to Honolulu, on the 4th, due to shifting of logs on deck, probably because of rough weather.

Marine Weather Diary

NORTH ATLANTIC, JUNE

WEATHER over the North Atlantic is usually very pleasant in June. The number of active extratropical LOWs continues to decline, and storms are usually confined to the higher latitudes--centers north of 45°N over the western ocean and 55°N over the eastern ocean. The building Azores High averages near 1024 mb for the month and is centered over midocean near 33°N, 38°W. The Icelandic Low, oriented east-west, is quite diffuse with the lowest average pressure about 1010 mb, just off the coast of Labrador, near 58°N.

WINDS are controlled largely by the Azores High, with the transient LOWs causing the daily variations. Between 25° and 55°N, southwesterly winds predomi-

nate, except over the eastern ocean from the Bay of Biscay southeastward, where northerly winds prevail. South of 25° to about 5°N, the "northeast trades" are generally steady. North of 55°N, winds are mostly variable. On the Mediterranean, east to southeast winds are common over the western half, while northwest winds blow steadily over the eastern portion. Northerly winds are predominant off the Iberian Peninsula and northwest coast of Africa. Northwesterly winds prevail over the eastern Gulf of Mexico, while southeasterly winds are predominant over the southern North Atlantic between the Equator and 5°N. Windspeeds over most of the North Atlantic during June are force 3 to 4. Lighter force 2 to 3 winds are most common over the Mediterranean Sea, Davis Strait, Gulf of Mexico, Bay of Biscay and waters southwestward, and near the Equator. A band of force 4 to 6 extends northeastward from the vicinity of Bermuda toward Ireland.

GALES over the North Atlantic are infrequent during June. Only in the waters near southern Greenland and over northern portions of the Norwegian Sea does the probability of encountering gales exceed 10 percent.

EXTRATROPICAL CYCLONES are fewer in June than in May and not as intense. Cyclogenesis throughout the summer occurs principally in the area from the Carolinas, west of 65°W, to Hamilton Inlet, Labrador, west of 50°W; north of Scotland; northwest of Iceland; over the waters southwest of the British Isles; and over the Gulfs of Finland, Riga, and Bothnia. The major storm tracks during June extend from the Newfoundland area northeastward to the waters south of Iceland, and then east-northeastward across the Scandinavian Peninsula. Another primary track extends from Iowa across central Lake Michigan to southern Lake Huron and down the St. Lawrence River, where it joins a track that develops off Cape Cod.

TROPICAL CYCLONES. Tropical storms average about one every 2 yr. The preferred area of tropical cyclone formation is over the western Caribbean and the Gulf of Mexico. The 44-yr period, 1931-74, had 24 tropical storms, of which 11 reached hurricane strength.

SEA HEIGHTS of 12 ft or more occur between 5 and 10 percent of the time over a broad area that includes the Labrador Sea, around the southern Greenland coast into Denmark Strait, then south of Iceland to the Faeroe Islands and southward to off Ireland's west coast, then southwestward to about 500 mi off Cape Race, and northwestward to include again the Labrador Sea. Other small areas are located between Norway and the Shetland Islands, off the central Norwegian coast, and in the Gulf of Lions. Frequencies of 10 percent or more occur only over an elliptical area immediately south of Kap Farvel. A flat oval area of swell greater than 12 ft over 10 percent of the time is centered about 55°N, from south of Kap Farvel to Ireland. The oval changes from about 5° to 10° of latitude thick from west to east. An area of over 20 percent occurs about 200 mi off the coast of Colombia.

VISIBILITY. The frequency of fog approaches its maximum over the northern ocean. The Grand Banks is the foggiest region--visibility below 2 mi is reported on more than 30 percent of all observations. The percentage of this low visibility decreases to between 20 and 30 percent of the observations over the Davis Strait and the northern Labrador Sea, and over the waters east of Kap Brewster, Greenland. The latter area is usually ice-covered at this time of year. The fog is generally observed in warm, moist air brought by southerly winds into this area of cold ocean temperatures.

NORTH PACIFIC, JUNE

WEATHER. The summer regime is well established over the North Pacific in June. Vigorous extratropical storms are increasingly less frequent. The Subtropical High is centered near 36°N, 149°W, and has an average central pressure of about 1022 mb. The Aleutian Low, located north of the western Aleutian Islands, fills rapidly during June; by the end of the month, it has disappeared, leaving only a trough.

WINDS north of the trade wind belt are variable over the broad scale, ranging from northwesterly to northerly off the United States and Canadian coasts, to southerly east of Japan, to westerly over the Aleutians. Over the Gulf of Alaska, they are southerly to westerly. Northeast of Hawaii, the winds blow from the northeast. The speeds average force 3 to 4 north of 25°N. South of 25°N (30° east of 145°W) to the Equator, steady "northeast trades" dominate, with force 4 the most common speed. The southwest monsoon is established over the South China Sea. Southeasterlies prevail over the Philippine Sea, switching to southerly south of Japan and Korea.

GALES are rare in June. Only over a small area near 46°N, 145°W, does the chance of encountering gales exceed 5 percent.

EXTRATROPICAL CYCLONES. The most favorable area for cyclogenesis continues to be east of Honshu. The primary storm tracks lead from here east-northeastward to the Gulf of Alaska. Another track approaches the Gulf of Alaska on a northeasterly course from midocean.

TROPICAL CYCLONES. The probability of tropical storm development continues to rise sharply in June, approaching the late summer and early fall maximum. On the average, three of these storms develop per year--one or two during this month in Asiatic waters, and one or two over the ocean area between 10° and 20°N, and the Mexican west coast and 120°W. About two out of three western North Pacific tropical storms go on to become typhoons. One out of three eastern North Pacific storms reach hurricane intensity.

SEA HEIGHTS of 12 ft or more have a frequency greater than 10 percent only in two small areas. One is centered south of the Alaska Peninsula near 48°N, and the other south of the western Aleutians near 46°N. Generally, sea conditions are improving as summer approaches. Areas of high swell are located in the northern Gulf of Alaska and Bering Sea, south of the ice edge.

VISIBILITY. The frequency of low visibility increases over most of the North Pacific. The waters east of the northern Kuril Islands are particularly foggy, with the visibility dropping below 2 mi in over 40 percent of the observations. From the outer boundaries of this area northward to Kamchatka, southward to the central Kurils, westward to the eastern Sea of Okhotsk, and eastward to 162°E, this percentage drops to 30 to 40 percent of all observations. The area of low visibility, which encompasses 20 to 30 percent of all observations, extends from the southern Sea of Okhotsk through the central Kurils, and then eastward through the North Pacific along the 40th parallel to 165°W. The line bordering the boundary of the area then bends westward to midocean near 47°N, 175°E, before curving northeastward through the central Aleutians to St. Lawrence Island in the Bering Sea.

NORTH ATLANTIC, JULY

WEATHER conditions are relatively settled during July as the Azores High, centered near 35°N, 44°W, builds to a seasonal maximum of about 1025 mb, and primary storm tracks are displaced north of 45°N. The Icelandic Low remains an ill-defined east-west trough with the lowest pressure, about 1009 mb, centered near Hudson Strait in eastern Canada.

WINDS over the middle and northern latitudes have southerly and westerly components. Northerly winds are common near the entrance to the Mediterranean, while over the Sea itself, northwesterly winds are steady. Winds from the northerly quarter are found over the North Sea, off the central Norwegian coast, and over the Davis Strait and the waters southwest of Iceland. The "northeast trades" blow between 10° and 25°N, while in the Gulf of Mexico, easterly winds are most frequent. Near the Equator, southeasterlies dominate the area between South America and Africa. Windspeeds average about force 3 to 4 over most of these areas except over the Mediterranean Sea, the Davis Strait, and the Gulf of Mexico, where force 2 to 3 winds are prevalent. The strongest winds, of which nearly two-fifths of all observations are force 5, are encountered over the waters of the southwestern Caribbean Sea.

GALES. The frequency of gales is at a minimum for the year. Only over the Norwegian Sea is the percentage frequency of gales 10 percent or higher.

EXTRATROPICAL CYCLONES. From June to July, a marked northward shift of cyclonic activity occurs over the North Atlantic. Areas of cyclogenesis are along the North American coast from the Carolinas to north of Newfoundland, in the Denmark Strait, southwest and north of the British Isles, in the Adriatic Sea, and over the Gulfs of Bothnia, Finland, and Riga. The primary cyclone tracks lead from the Hudson Bay region northeastward through the Davis Strait, from the Grand Banks and the Gulf of St. Lawrence toward Iceland, and from north of Scotland eastward across southern Scandinavia. Two secondary tracks cross the Great Lakes. One extends from the Great Plains across eastern Lake Superior toward Labrador, while the other cuts an east-northeasterly swath across Lakes Erie and Ontario, New York, and New England, before merging with the Carolina storm track over the Gulf of St. Lawrence.

TROPICAL CYCLONE activity is still limited. On an average, three storms will occur during a 4-yr period, and half will develop into hurricanes. July tropical cyclones usually originate over the Gulf of Mexico or just east of the Lesser Antilles. Those forming over the Gulf generally move northward across the Gulf Coast, while those born east of the Lesser Antilles may move westward across the Caribbean Sea, or northwestward toward the southeast coast of the United States, where they often recurve to the northeast. Sometimes these storms are bred north and east of the Bahama Islands during July.

SEA HEIGHTS of 12 ft or more are encountered with a frequency of 10 percent or more only in a small area immediately south of southern Greenland.

VISIBILITY. Like June, July is one of the foggiest months of the year over the western North Atlantic. Observations with visibility less than 2 mi average 10 percent or more northward of a line drawn from the waters between Cape Cod and Cape Sable northeastward to near 60°N, 30°W. From there, the 10-percent frequency line runs eastward, south of Iceland, to near the Faeroe Islands, and then southward, cutting across Scotland near the Firth of Forth. The line then extends northward along the Prime Meridian to about 63°N, where it heads northeastward to the coast of Norway. The 20-percent frequency line is a little less erratic. It extends from near Cod Island, Labrador, eastward to near 56°N, 47°W; it then extends southwestward across Newfoundland to the Grand Banks. From there, visibilities less than 2 mi occur 20 percent or more of the time west of a line drawn to the coastal waters of Greenland, near Kap Mosting, and then north of the same line extended to 74°N, 20°E. Enclosed within the area defined by Godthaab (Greenland), Resolution Island, and Ivigtut (Greenland), observations with visibility less than 2 mi exceed 30 percent.

NORTH PACIFIC, JULY

WEATHER. The steady and rather settled summer weather conditions that commenced in June over the North Pacific become widespread and firmly established during July. The Aleutian Low has disappeared from the pressure chart of normals, and the Subtropical High, with a pressure of 1026 mb, has moved northward to near 38°N, 150°W.

WINDS. Because of the strong development and northward position of the Subtropical High, the "northeast trades" extend over a large portion of the ocean. They prevail over all but Asiatic waters south of 30°N. Over the eastern ocean, they extend northward to about 35°N. The southwest monsoon is well established in Asiatic waters, blowing most steadily over the South China Sea. The westerlies of the middle latitudes, because of the absence of the Aleutian Low, are less steady than during the colder months. Large south-

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erly components are found over the western two-thirds of the ocean at these latitudes, while northerly components are the rule closer to the conterminous United States and are also observed out from the Gulf of Tehuantepec. Easterly winds prevail over the waters of the Gulf of Alaska. Windspeeds over the Pacific average slightly less than force 4.

GALES associated with extratropical cyclones are rare during July over almost all of the North Pacific, but a frequency greater than 5 percent does exist over a 2° square north of the central Aleutians.

EXTRATROPICAL CYCLONES. Cyclogenesis during the summer occurs in Asiatic waters from Taiwan northward to Sakhalin, and northeastward to the Near Islands. The greatest frequency is east of Honshu and Hokkaido. Two other areas are found near 47°N, from 155° to 175°W, and over the Gulf of Alaska. The primary storm tracks lead from Honshu northeastward to the Bering Sea, and from a point near 52°N, 157°W, to the Gulf of Alaska.

TROPICAL CYCLONES. Usually three or four tropical storms occur over the western North Pacific during July. Only one of these will not become a typhoon. These storms originate mostly over the ocean areas east of the Philippines. During their early stages, they generally move west-northwestward; after development, some may continue across the northern Philippine Islands into the South China Sea, while others curve northwestward toward Taiwan, the coast of mainland China, Korea, or Japan. Those reaching higher latitudes generally recurve toward the northeast under the influence of the upper westerlies.

Another area of tropical cyclone activity is over the waters off the west coast of Mexico. Around four tropical storms can be expected in July, with one reaching hurricane force. These storms are usually shorter lived, but can be dangerous to both marine and coastal interests. They normally move west-northwestward out to sea, but sometimes they pass inland over Baja California.

SEA HEIGHTS of 12 ft or more may be expected about 10 percent of the time in two small areas south of the Aleutians, near 48°N, 165°E, and near 49°N, 155°W. Areas of high swells are located in the Gulf of Alaska and Sea of Okhotsk.

VISIBILITY. Compared to other months of the year, the occurrence of low visibility over northern waters is most frequent during July. The visibility drops below 2 mi in over 40 percent of all observations over a circular area bordering the northern Kurils on the west and centered near 48°N, 158°E. The 30-percent frequency line is less circular, running from southwestern Kamchatka across the central Kurils to a point near 43°N, 160°E, and then northeastward to the Rat Islands, before swinging westward to Mys Shipunskiy. The 20-percent frequency line also crosses the central Kurils, but extends farther up the west coast of Kamchatka. This line then continues southeastward from the Kurils reaching south of 40°N, between 160°E and the dateline, before moving east-northeastward to a point near 48°N, 145°W, and then north-northwestward to Afognak Island. The entire Bering Sea is enclosed within this 20-percent frequency line, with the exception of the waters northeast of St. Lawrence Island, and the waters north of a line drawn from Mys Ozernoy to Mys Navarin. The 10-percent frequency line is very similar to the 20-percent one. It stretches from the northern Sea of Okhotsk southward to the southern Kurils; it then continues southeastward to a point near 34°N, 170°E, before shooting east-northeastward to about 40°N, 140°W, and then north-northwestward to the Gulf of Alaska.